C1013

Attachment H

COVER SHEET (PAGE 1 of 2)

May 1998 CALFED ECOSYSTEM RESTORATION PROPOSAL SOLICITATION

Proposal Title: Tuolumne River Special Run Pool 10 Restoration

Applicant Name: Turlock Irrigation District

Mailing Address: P.O. Box 949 Turlock, CA 95381

Telephone: (209) 883-8316

Fax: (209) 656-2143

Amount of funding requested: $ 2,101,000 for 3 years

Indicate the Topic for which you are applying (check only one box). Note that this is an important decision: see page __ of the Proposal Solicitation Package for more information.

- ☐ Fish Passage Assessment
- ☐ Fish Passage Improvements
- XX Floodplain and Habitat Restoration
- ☐ Gravel Restoration
- ☐ Fish Harvest
- ☐ Species Life History Studies
- ☐ Watershed Planning/Implementation
- ☐ Education
- ☐ Fish Screen Evaluations - Alternatives and Biological Priorities

Indicate the geographic area of your proposal (check only one box):

- ☐ Sacramento River Mainstem
- ☐ Sacramento Tributary: ______
- ☐ Delta
- ☐ East Side Delta Tributary: ______
- ☐ Suisun Marsh and Bay
- XX San Joaquin Tributary: Tuolumne
- ☐ San Joaquin River Mainstem
- ☐ Other: ______
- ☐ Landscape (entire Bay-Delta watershed)
- ☐ North Bay: ______

Indicate the primary species which the proposal addresses (check no more than two boxes):

- XX San Joaquin and East-side Delta tributaries fall-run chinook salmon
- ☐ Winter-run chinook salmon
- ☐ Spring-run chinook salmon
- ☐ Late-fall run chinook salmon
- ☐ Fall-run chinook salmon
- ☐ Delta smelt
- ☐ Longfin smelt
- ☐ Splittail
- ☐ Steelhead trout
- ☐ Green sturgeon
- ☐ Striped bass
- ☐ Migratory birds

COVER SHEET (PAGE 2 of 2)

May 1998 CALFED ECOSYSTEM RESTORATION PROPOSAL SOLICITATION

Indicate the type of applicant (check only one box):

☐ State agency	☐ Federal agency
☐ Public/Non-profit joint venture	☐ Non-profit
☒X Local government/district	☐ Private party
☐ University	☐ Other: ______________

Indicate the type of project (check only one box):

☐ Planning	☒X Implementation
☐ Monitoring	☐ Education
☐ Research	

By signing below, the applicant declares the following:

(1) the truthfulness of all representations in their proposal;

(2) the individual signing the form is entitled to submit the application on behalf of the applicant (if applicant is an entity or organization); and

(3) the person submitting the application has read and understood the conflict of interest and confidentiality discussion in the PSP (Section II.K) and waives any and all rights to privacy and confidentiality of the proposal on behalf of the applicant, to the extent as provided in the Section.

Paul [signature]

(Signature of Applicant)

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I-009023

TUOLUMNE RIVER SPECIAL RUN POOL 10 RESTORATION

II. EXECUTIVE SUMMARY

SUBMITTED BY: TURLOCK IRRIGATION DISTRICT

DESCRIPTION:

The Special Run Pool (SRP) 10 Restoration Project involves restoration of instream aquatic habitat and shaded riverine aquatic habitat and reduction of predatory fish habitat for the primary benefit of San Joaquin River fall-run chinook salmon. The project will rebuild a select portion of the Tuolumne River channel, at river mile 25.4, (approximately 15 miles east of Modesto) where past instream gravel mining created a large deep lake area in the main channel. That changed the habitat to one favoring warm water predator species like largemouth bass. This project will return this portion of the river to a more natural, dynamic morphology that will improve, restore and protect instream and riparian habitat for fall run chinook salmon survival, including restoring hydrological and geomorphic processes. The channel will be reformed into a 500 foot wide riparian flood plain re-creating a riffle and run pattern that follows the restored meander channel of the river along with native vegetation planted on fill terraces in a mix similar to that found on undisturbed segments of the river. This is the second of two adjacent SRP restoration projects, SRP's 9 & 10, in this reach of the river.

BIOLOGICAL OBJECTIVES:

1. Reduce salmonid fish predator habitat.
2. Restore and increase habitat for natural salmon production.
3. Reconstruct a natural channel geometry scaled to current channel forming flows.
4. Restore native riparian plant communities within their predicted hydrological regime.

TASKS & SCHEDULES:

The CEQA/NEPA mitigated EA/IS, permitting, and construction design for both SRP 9 & 10 is being funded under current AFRP contracts and contributions from TID, MID, and CCSF. Construction funded by AFRP and CALFED, in the upstream SRP 9 will start in June 1999 and be completed in March 2000, including revegetation. Construction of SRP 10 requires two years and would start in June 2000 and be completed in March 2002, including revegetation.

JUSTIFICATION:

The fall run chinook salmon in the tributaries of the San Joaquin River are currently listed as a species of concern by the USFWS. Anadromous salmonid populations in the lower Tuolumne River require adequate ecosystem health to achieve and sustain their potential productivity. Restoring and maintaining dynamic geomorphic processes are crucial for insuring healthy river ecosystems with natural productive salmonid populations. When complete restoration of a river ecosystem is infeasible, as for alluvial rivers regulated by dams, limiting factors, like predator habitat and poor quality riverine habitat, must be identified for prioritizing actions that would best improve the ecosystem, particularly salmonid habitat. Predation on juvenile salmon has been identified through field studies in the Tuolumne River as having a significant impact on survival of salmon in the Tuolumne River. Currently nearly all naturally

TUOLUMNE RIVER SPECIAL RUN POOL 10 RESTORATION

III. TITLE PAGE

Project Manager
Turlock Irrigation District
333 East Canal Drive
Turlock, CA 95380

Wilton Fryer
Water Planning Department Manager
209-883-8316
FAX 209-656-2143
e-mail: wbfryer@tid.org

APPLICANT:

The Turlock Irrigation District (TID) is a California irrigation district, a political subdivision of the State of California. TID is a tax exempt public agency.

CONTACTS:

For contract and project administration:	Wilton Fryer
For fishery and habitat details:	Tim Ford 209-883-8275 FAX 209-656-2143 e-mail: tjford@ainet.com

PARTICIPANTS:

Tuolumne River Technical Advisory Committee (TRTAC) made up of the Turlock Irrigation District (TID), Modesto Irrigation District (MID), City & County of San Francisco (CCSF), California Dept. of Fish & Game (CDFG), and the US Fish & Wildlife Service (USFWS). Collaborating stakeholder groups with TRTAC are the Tuolumne River Preservation Trust, Friends of the Tuolumne, California Sports Fishing Protection Alliance , Bay Area Water Users Association, East Stanislaus Resource Conservation District, National Marine Fishery Service (NMFS),and local mining operators and landowners.

COST SHARE PARTICIPANTS:

Turlock Irrigation District, Modesto Irrigation District, and City & County of San Francisco through the TRTAC and the US Fish & Wildlife Service AFRP.

PROJECT GROUP:

Group C — The CALFED is being asked to fund portions of the public works construction for this floodplain and riverine restoration project.

IV. PROJECT DESCRIPTION

A. PROJECT DESCRIPTION AND APPROACH

The Tuolumne River Technical Advisory Committee (TRTAC), under the auspices of the 1995 Don Pedro Project Settlement Agreement (FERC License No. 2299), is developing a plan to restore instream aquatic habitat and shaded riverine aquatic habitat for the primary benefit of San Joaquin fall-run chinook salmon in the Tuolumne River below La Grange dam. The TRTAC specifically identified both SRP 9 & SRP 10 as prime "predator isolation" projects for the Tuolumne River. The geomorphology firm of McBain & Trush has developed a detailed description of the proposed restoration work for the TRTAC.

These two adjacent restoration segments including their associated revegetation, are to be reconstructed over a three to four year period, with SRP 9 to be reconstructed first starting in 1999 followed by SRP 10 starting in 2000. These two SRPs are stand alone projects, however the CEQA/ NEPA mitigated EA/IS, permitting, civil design, and revegetation design are being done together to facilitate future CALFED and AFRP funding for the SRP 10 restoration construction. SRP 9 is planned for one year of construction and SRP10 is anticipated to take two years to construct given the volume of material involved. The Air Resources District mitigation proposed in the EA/IS indicated that construction of SRP 9 should be over two years . because of construction planned for the Mining Reach restoration projects during the same period. The landowners adjacent to the SRP projects have asked the TID to seek a variance that would allow SRP 9 to be constructed in the original one year period to minimize impacts to their land and farming operations. This CALFED funding request is being made at this time in anticipation that the variance will be granted.

The restoration work consists of filling in deep (10 to 34 feet below normal channel grade in SRP 10) lake like pool areas created by past instream gravel mining and re-creating a riffle and run pattern that follows the restored meander channel of the river. The channel will be reformed into a 500 foot wide riparian flood plain complete with native vegetation planted on fill terraces in a mix similar to that found along undisturbed segments of the river. The aerial extent of the project area including the restoration work proposed is shown in RFP Figure 5, from the project description in the EA/IS. In the McBain & Trush design report, Appendix 1, Figures 4 & 5 show typical cross-sections through the restored area. The reconstructed floodway channel cross-section will be hydraulically sized to be an active riverine channel at currently regulated flows. These flows periodically could reach as high as 15,000 cfs for short periods. The rebuilt channel is sized assuming a river stage elevation that results from full grown riparian forest vegetation at design flows. It is anticipated and planned that during these high flow events there will be some movement of the channel within the flood plain to expose added spawning materials and clean existing spawning gravels. To minimize long term future maintenance expenditures, this restoration work is being designed with the intent to provide a self maintaining riparian floodway channel once the revegetation is completed and established.

B. GENERAL CONDITIONS OF PROPOSED WORK

The SRP 9 & SRP 10 projects were originally developed as one project because of their proximity to each other along the river. From a practical construction and funding view point they are two projects, each with a very similar scope of work. The lessons learned in first constructing the smaller SRP 9, will be incorporated in adjusting the final design of SRP 10.

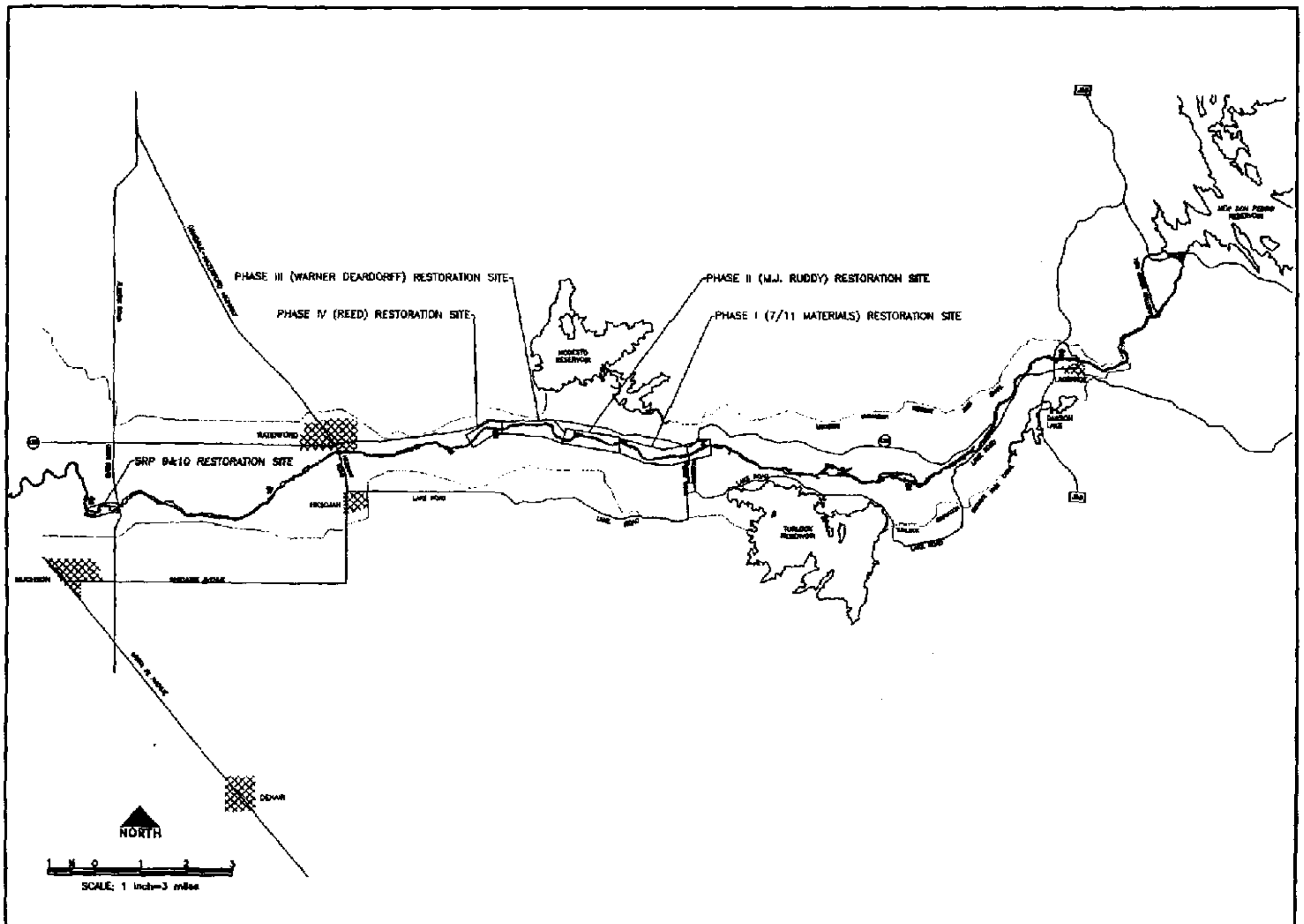
The heavy reconstruction work in the river is anticipated to be limited for fishery reasons to an annual opportunity window of about 90 work days from mid-June through September when salmon are not as abundant in the river. It may be possible to stockpile fill materials at the site before the 90 day period to reduce the truck traffic during the construction period. Construction above the water level can proceed after September, but should be completed before about December to avoid the potential of early flood releases damaging incomplete work and to allow for revegetation planting. The restoration plantings are also seasonally restricted to the winter months when planting materials are dormant. Construction design, revegetation design, CQA/NEPA through a mitigated EA/IS, permitting, and acquisition of conservation easements are being done for both SRP 9 & 10 in 1998 using AFRP funding, The funding requests may be divided along the different design, construction, and revegetation phases of the project for ease of managing and tracking the differing funding sources.

The materials for this project will need to be imported into the site. The anticipated sources of materials are deposits of dredger tailings along the upper Tuolumne River. One benefit of using the tailings from the Tuolumne is that it may be possible to restore additional floodplain habitat during the mining of the excavation areas. We may also utilize some of the clean rock materials from January 1997 flood debris excavated from La Grange reservoir. Alternatively, the material could come from active off channel and off site gravel mining areas between Geer Road and La Grange. Additionally there are tailing deposits near Snelling along the Merced River. The project EA/IS identified and addressed mitigation for utilization and transportation of the various sources of restoration materials available for this project. The materials cost estimates were originally based on the La Grange reservoir source and include excavation, hauling, and haul road construction costs. The materials are owned by TID and MID and they will donate the available material as a cost share contribution. These cost estimates compare favorably with purchasing materials from locally permitted sources that represent shorter haul distances.

Recreation of the riparian floodway habitat zone raises an issue of long term maintenance of project improvements. TID and MID are working with the landowners to develop some form of locally administered conservation easement process that protects the public investment, but at the same time protects the landowner property rights.

C. LOCATION

The Special Run Pool 10 Restoration Project will rebuild a 2,100 foot long portion of the Tuolumne River channel, starting at river mile 25.4, downstream of the Geer Road bridge crossing the Tuolumne River, approximately 15 miles east of Modesto in Stanislaus County. The project location is shown in RFP Figure 1.



McBain & Trush 1998

FIGURE 1. TUOLUMNE RIVER
GRAVEL MINING REACH AND SRP 9&10
RESTORATION SITE LOCATIONS

6/18/98

D. EXPECTED BENEFITS

1. Reduce salmonid fish predator habitat.
2. Restore and increase habitat for natural salmon production.
3. Reconstruct a natural channel geometry scaled to current channel forming flows.
4. Restore native riparian plant communities within their predicted hydrological regime.

The SRP reach projects address the ERPP objectives and visions for the Tuolumne River Ecological Unit identified on pages 409 & 410 of the ERPP Vol. II. These include restoration of stream & riparian habitat; ecological processes; gravel recruitment, transport, and cleaning processes; a diverse self-sustaining riparian corridor; and predator reduction.

E. BACKGROUND & TECHNICAL JUSTIFICATION

The Tuolumne River is a major tributary of the San Joaquin River. The Don Pedro Project is the largest reservoir located above the fall-run chinook salmon spawning reach on the Tuolumne. Don Pedro Reservoir is owned by the Turlock Irrigation District (TID) and the Modesto Irrigation District (MID) and is licensed by the Federal Energy Regulatory Commission (FERC).

The fall run chinook salmon in the tributaries of the San Joaquin River are currently listed as a species of concern by the USFWS. Anadromous salmonid populations in the lower Tuolumne River require adequate ecosystem health to achieve and sustain their potential productivity. Restoring and maintaining dynamic geomorphic processes are crucial for insuring healthy river ecosystems with natural productive salmonid populations. When complete restoration of a river ecosystem is infeasible, as for alluvial rivers regulated by dams, limiting factors, like predator habitat and poor quality riverine habitat, must be identified for prioritizing actions that would best improve the ecosystem, particularly salmonid habitat. Predation on juvenile salmon and smolts has been identified through field studies as having a significant impact on survival of salmon in the Tuolumne River. Currently nearly all naturally produced juvenile salmon must pass through SRP 9 and SRP 10. Reducing predator habitat by reconstructing riparian floodplain meets these desired priority actions.

The TRTAC specifically identified habitat conditions to be improved to enhance natural salmon production in the Tuolumne River. The TRTAC has developing a final draft integrated, long-term restoration plan and monitoring program that utilizes adaptive management for enhancing the natural production of salmon. The TRTAC and the AFRP have each funded $105,000 towards this integrated restoration plan. The river has been divided into four reaches with 14 segments representing specific types of restoration projects within each reach. There are projects that focus on restoration of geomorphic processes, others for riparian restoration and predator reduction, and still others deal with gravel re-introduction and cleaning.

The Tuolumne River supports a population of fall-run chinook salmon, whose numbers have fluctuated from 40,000 fish in 1985, to a low of 100 fish in 1991, and is on another upward swing with 7,000 spawners in 1997. The underlying premise of this project is that by creating the proposed sustainable riverine habitat both the native fishery and riparian species will benefit and stressors will be reduced. The prime target of this project is to improve the survival of juvenile salmon and smolts by reducing the habitat of introduced predator species, primarily largemouth bass. The impacts of predators on smolt survival are based on feeding studies conducted by EA Engineering for the Districts. The riparian reforestation is intended to provide food and shade for the juvenile salmon. There is the added benefit to terrestrial species in providing a more continuous corridor of riparian habitat in the restored areas. The restored channel sinuosity is intended to provide a sustainable and dynamic river morphology, i.e. infrequent flood-related channel-bed movement with periodic scour, that partially or fully restores the processes associated with natural salmon production and survival.

This proposed restoration project provides long term low maintenance predator control combined with habitat restoration. This can be contrasted with an annual system of non-selective predator control, such as electroshocking, tournament fishing, poisoning, etc., that has a lower up front cost. However, this alternative solution requires continued annual expenses, is of limited effectiveness in targeting the primary predators, has unfavorable social consequences, and does not meet the intent of the CALFED solutions by providing an improved self sustaining riverine habitat for salmon. Such alternatives will not be considered further.

F. IMPLEMENTABILITY

This is the fourth of several restoration projects being proposed for the Tuolumne River based on the restoration plan developed by the TRTAC. The staff is also working closely with the affected landowners in the development of site specific adjustments to the preliminary plans. The firm EDAW, Inc. was hired to assist with the CEQA, NEPA, and permitting work. The NEPA portion was coordinated with NEPA work developed by the USFWS and coordinated with the AFRP program. A mitigated EA/IS was jointly developed between the TID, as project manager & lead agency, and the USFWS as a Federal funding agency. The EA/IS tiers off the 1995 EIS for the FERC Settlement Agreement for the Don Pedro Project.

A partial list of the anticipated permits and agencies to be dealt with prior to construction is as follows: 404 Fill & Dredge Permit from the USCOE; 1600 Series Streambed Alteration Agreement from CDFG, a mining lease and Boundary Delineation finding from the State Lands Commission; an exemption from the SMARA permit by the CMGB; Stanislaus County use permit; RWQCB 401 waiver for water quality; and an Encroachment Permit from the Reclamation Board.

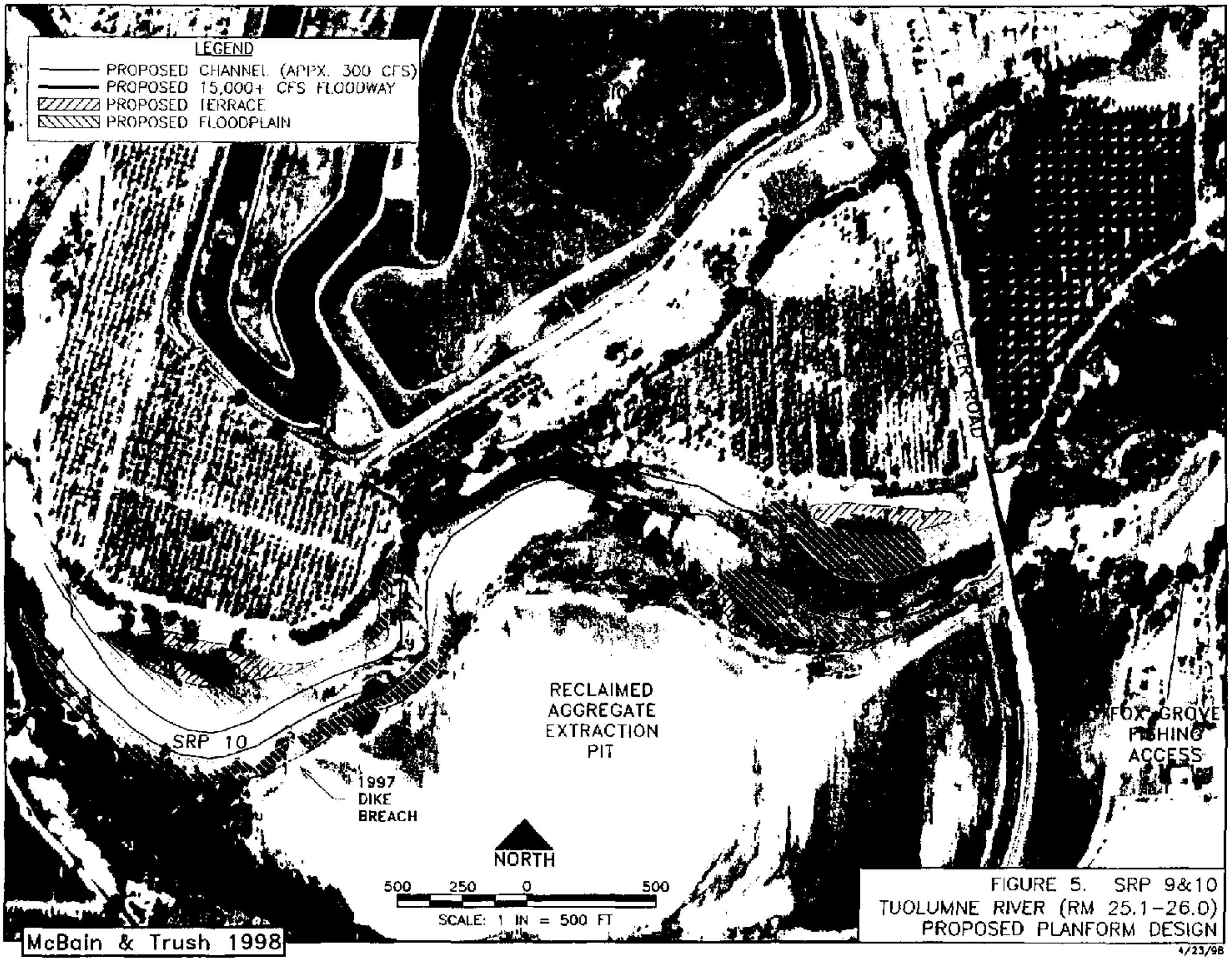


FIGURE 5. SRP 9&10
TUOLUMNE RIVER (RM 25.1-26.0)
PROPOSED PLANFORM DESIGN

G. MONITORING PLAN

A detailed mitigation and monitoring plan was developed with the project EA/IS. Assuming funding for this project, Tables 1 and 2 summarize the basic monitoring program over the life of the restoration project. The key monitoring plan sections are attached in Appendix 2. The monitoring plan can be grouped into three basic areas.

1. Physical habitat changes:
   Pre and post construction changes will be recorded from the as-built engineering drawings. This assures that the desired channel contours and cross sections were built as designed and these as-built records can be used to assess future geomorphological changes after major flood events.

2. Riparian habitat changes:
   Revegetation will require annual inspections during the first few years to confirm survival of planted materials, perform replanting if deemed necessary, and to assess natural changes in the vegetation mix. Monitoring vegetation would then be reduced to evaluations after significant flood events.

3. Fish population changes:
   This will involve evaluation of pre and post project changes in habitat conditions for both fish predators and salmon. Monitoring criteria would include items such as flow velocity, temperature, comparisons of estimated transit time through the old vs. new stream channel, combined with sampling and observations of fish populations and spawning riffle conditions.

Table 1. Monitoring schedule based on a sequence of hypothesized peak flows, to illustrate the proposed monitoring scheme.

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Hypothetical annual peak discharge		*Q=3650cfs*	*Q=7280cfs*	*Q=2980cfs*	*Q=1200cfs*	*Q=10400cfs*	*Q=8010cfs*	*Q=5870cfs*		
CONSTRUCTION										
SRP 9 and 10		***SRP 9***	***SRP 10***							
GRAVEL MINING REACH		***PHASE I***	***PHASE II***	***PHASE III***	***PHASE IV***					
MONITORING										
SRP 9										
GEOMORPHOLOGY	pb	ab,rx		rx, n, xs, thal		rx*, xs, thal	xs	xs, thal		
FISHERIES	ef, sv, map	ef, sv, map, sss	ef, sv, sss	ef, sv, sss	sss	sss	sss	sss#		
RIPARIAN		ab, pp, $	$	pp		pp		pp		
SRP 10										
GEOMORPHOLOGY		pb		ab, rx, xs, thal		rx*, xs, thal	xs	xs, thal		
FISHERIES	ef, sv, map	ef, sv	ef, sv, sss	ef, sv, map, sss	sss	sss	sss	sss#		
RIPARIAN				ab, pp, $	$	pp		pp		pp
GRAVEL MINING REACH PHASE I										
GEOMORPHOLOGY	pb	ab,rx		n, rx, xs, thal		rx*, xs, thal	xs, thal	xs, thal		
FISHERIES	map	map, sss	sss	sss	sss	sss	sss	sss#		
RIPARIAN		ab, pp, $	bio, $	pp	pp	bio		pp, bio		
GRAVEL MINING REACH PHASE II										
GEOMORPHOLOGY	pb			ab, n, rx, thal		rx*, xs, thal	xs, thal	xs, thal		
FISHERIES		map	map, sss	sss	sss	sss	sss	sss#		
RIPARIAN			ab, pp, bio, $	$	pp	pp, bio	bio		pp, bio	
GRAVEL MINING REACH PHASE III										
GEOMORPHOLOGY	pb			ab, rx thal		rx*, n, xs, thal	xs, thal	xs, thal		
FISHERIES			map	map, sss	sss	sss	sss	sss#		
RIPARIAN				ab pp, $	$	pp, bio	pp, bio	bio		pp
GRAVEL MINING REACH PHASE IV										
GEOMORPHOLOGY			pb		ab, rx	rx*, xs, thal	n, xs, thal	xs thal		
FISHERIES				map	map, sss	sss	sss	sss#		
RIPARIAN					ab, pp, $	$	pp	pp		pp
ANNUAL BUDGET:	$92,565	$109,192	$154,028	$124,696	$74,619	$184,773	$142,269	$98,230	$20,416	$10,588

Geomorphology symbols pb=pre-built channel topography, ab=as-built channel topography; n=manning's "n"hydraulic calculation; rx= bed mobility with tracer rocks; thal= channel vertical adjustment w

xs= channel planform adjustment with cross-section profiles, *=bed mobility observed;

Fisheries symbols: ef=bass abundance by electrofishing; sv=smolt survival estimate, map=habitat mapping; sss=annual spawning and seining surveys, # denotes that spawning surveys will occur annu

Riparian symbols: pb=pre-built vegetation; ab=as-built vegetation; pp=project performance plots; bio=bioengineered bank protection; $=last year of irrigation

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Table 2. Estimated costs associated with the hypothesized monitoring schedule. The budget assumes all monitoring components are implemented as described in the schedule.

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	TOTAL
SRP 9 and 10											
Geomorphic Processes	$1,563	$3,480	$20,880	$0	$0	$19,530	$15,610	$3,920	$0	$0	$64,983
Fisheries Resources	$75,670	$56,415	$58,515	$51,060	$4,200	$2,100	$0	$0	$0	$0	$247,960
Riparian Resources	$0	$8,145	$0	$16,290	$8,145	$8,145	$16,290	$0	$8,145	$0	$65,160
SRP 9 AND 10 SUBTOTAL	$77,233	$68,040	$79,395	$67,350	$12,345	$29,775	$31,900	$3,920	$8,145	$0	$378,103
GRAVEL MINING REACH											
Geomorphic Processes	$1,563	$6,690	$31,815	$8,000	$8,655	$107,225	$71,065	$53,525	$0	$0	$288,538
Fisheries Resources	$5,355	$14,910	$17,010	$19,110	$18,960	$9,405	$4,200	$2,100	$0	$0	$91,050
Riparian Resources	$0	$9,625	$11,805	$18,900	$27,875	$21,570	$22,170	$29,755	$10,415	$9,625	$161,740
MINING REACH SUBTOTAL	$6,918	$31,225	$60,630	$46,010	$55,490	$138,200	$97,435	$85,380	$10,415	$9,625	$541,328
ANNUAL REPORT:	$8,415	$9 927	$14,003	$11,336	$6,784	$16,798	$12,934	$8,930	$1,856	$963	$91,943
ANNUAL BUDGET TOTAL	$92,565	$109.192	$154,028	$124,696	$74.619	$184,773	$142,269	$98,230	$20,416	$10,588	$1,011,373
GRAND TOTAL:	**$1,011,373**										
YEARLY AVERAGE:	**$101,137**										

V. COSTS AND SCHEDULES

BUDGET COSTS

The CALFED is being asked to fund 50% of the construction and 100% of the revegetation for the SRP 10 restoration this project. The total amount requested from CALFED is $2,101,000, consisting of $1,488,000 for construction, $234,000 for revegetation, $52,000 for project management (3%), $155,000 for construction management (9%), and a $172,000 construction contingency (10%). There are three phases of construction; inchannel fill, floodplain reconstruction, and revegetation, for each side of the river. The attached spreadsheet, Table 3 Tuolumne River SRP 10 Reach Restoration, details the cost breakdown. The USFWS-AFRP will also be asked to fund the balance of the public works construction, $2,095,000, including $228,000 in project monitoring.

TID has been coordinating with several different agencies to obtain funding for the SRP 9 and SRP 10 projects. TID, MID, and CCSF have provided $100,000 through the TRTAC for CEQA, NEPA (EA/IS), and permitting. The USFWS through AFRP is providing for pre-project monitoring and construction design.

The costs of this restoration project compare favorably with estimates prepared by DWR and CDFG for 4 Pumps financing of five planned predator isolation and habitat restoration projects along 3.5 miles of the Merced River near Snelling.

SCHEDULE

The attached Gantt chart schedule, Figure 2, shows the basic components of SRP 9 and SRP 10 restoration. The schedule shows SRP 9 constructed as a one year project, assuming our request for a variance from the Air Control District is granted. This funding request is designed to assure that funds for construction are available prior to bidding for the work that starts in June 2000. This will provide for a smooth continuum of construction that fits into the seasonal limits on instream restoration construction. Such funding assurances also provide an incentive for mobilized contractors to submit lower bids for future work.

THIRD PARTY IMPACTS

The parties most directly impacted by the proposed project are the local landowners at the project site, those along the haul road route, and the County Roads Department. TID staff and consultants have been and will continue to meet with the affected stakeholders to listen to and address their individual concerns. Recognizing those individual concerns, the landowners at the site contacted to date have been cooperative and supportive of the project. The EA/IS for all the SRP restoration projects outlines the mitigation and monitoring that are to be followed to minimize impacts associated with the restoration activities.

TABLE 3

PROJECT BUDGET SUMMARY

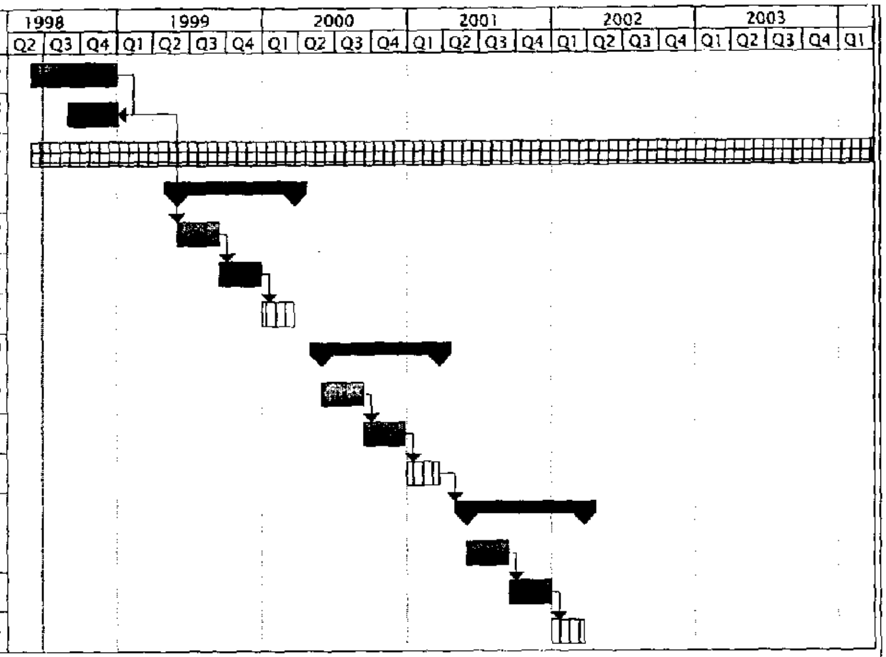
TUOLUMNE RIVER SRP 10 REACH RESTORATION

SRP 10 SEGMENT Rm 25.6 to 25.1

Construction Task from Figure 9	Description of work		Cost
Phase 2A	South Bank Restore Channel		833,000
Phase 2B	South Bank Restore Floodplain		358,000
Phase 3A	North Bank Restore Channel		1,249,000
Phase 3B	North Bank Restore Floodplain		536,000
	sub total		2,976,000
All Phases	Revegetation		234,000
All Phases	Monitoring		228,000
CALFED Share			
	50% of Construction		1,488,000
	100% of Revegetation		234,000
	sub total		1,722,000
	Contingency 10%		172,000
	Construction Management 9%		155,000
	Project Management 3%		52,000
	CALFED Total	**$**	**2,101,000**
AFRP Share			
	50% of construction		1,488,000
	100% of Monitoring		228,000
	sub total		1,716,000
	Contingency 10%		172,000
	Construction Management 9%		155,000
	Project Management 3%		52,000
	AFRP Total	**$**	**2,095,000**

Comments: The original SRP 9 & 10 proposal from McBain & Trush, Appendix 1, had overall inplace aggregate costs of $10.16 / CY for an estimated 293,000 CY. This has been prorated as 70% instream fill and 30% floodplain reconstruction with 60 % on the north side of the channel and 40% on the south side of the channel.

ID	Task Name	Duration	Start
1	SRP 9 & 10 Reach Design	154 days	Mon 6/1/98
2	SRP 9 & 10 Reach Permits	90 days	Tue 9/1/98
3	Project Monitoring	1523 days	Mon 6/1/98
4	**SRP 9**	**214 days**	**Tue 6/1/99**
5	Phase 1-A instream	77 days	Tue 6/1/99
6	Phase 1-B	77 days	Thu 9/16/99
7	Revegetation	60 days	Mon 1/3/00
8	**SRP 10 South Side**	**212 days**	**Thu 6/1/00**
9	Phase 2-B instream	75 days	Thu 6/1/00
10	Phase 2-B	75 days	Thu 9/14/00
11	Revegetation	60 days	Mon 1/1/01
12	**SRP 10 North Side**	**213 days**	**Fri 6/1/01**
13	Phase 3-A instream	76 days	Fri 6/1/01
14	Phase 3-B	77 days	Mon 9/17/01
15	Revegetation	60 days	Wed 1/2/02



Project: TUOLUMNE RIVER SRP9 & 10
REACH RESTORATION
Figure 2

Task	Summary	Rolled Up Progress
Split	Rolled Up Task	External Tasks
Progress	Rolled Up Split	Project Summary
Milestone	Rolled Up Milestone	

VI. APPLICANT QUALIFICATIONS

Since 1971, TID, MID, and CCSF, in cooperation with DFG and USFWS, have monitored river conditions and developed programs that enhance the natural production of fall-run chinook salmon in the Tuolumne River. The project manager for these activities has been TID.

TRTAC and Other Local Support for Project

The fluvial geomorphology firm of McBain & Trush was retained in 1996 by TID through the TRTAC to develop an integrated, long-term fish and riparian habitat restoration plan for the Tuolumne River below La Grange Dam and to prepare preliminary designs for specific restoration projects which have been approved by the TRTAC participants as high priority projects. The SRP 9 & 10 had long been identified as a portion of the river that had been substantially altered by past mining operations that would benefit from restoration of more natural geomorphic processes.

<u>Project Management</u>

The Project Manager is Wilton Fryer, P.E. Mr. Fryer graduated from the University of California at Davis with a BS in Soil & Water Science, an MS in Irrigation Science, and later an ME in Civil Engineering with an emphasis in water resources. He is currently registered as both a Civil Engineer and an Agricultural Engineer. Accomplishments are: Development and implementation of the Oakdale Irrigation District Irrigation Master Plan; Directed a $22 million canal rehabilitation project for OID where 54 miles of dirt canals were replaced with pipe; Development of the OID domestic water service system; Designer and project manager for a replacement water treatment plant for the La Grange Domestic Water System.

Tim Ford has been the staff aquatic biologist for TID and MID since 1981. Mr. Ford graduated from the University of California at Davis with a BS in Wildlife & Fisheries Biology in 1977. He worked as a Biological Technician for the Modoc, Tahoe, and Stanislaus National Forests prior to working for the Districts. Mr. Ford is tasked with planning, coordinating and conducting the aquatic resources program for the Districts, and his responsibilities at TID include field studies, program development, consultant supervision, and coordination with Don Pedro project operations.

Contracting support and financial service support as needed will be provided by TID staff.

The firm EDAW, Inc. has been retained to perform the CEQA and NEPA environmental work and to obtain necessary permits. The project EA/IS-Mitigated Negative Declaration will close for public comments on 2 July 1998 with adoption by the TID Board anticipated by 1 August 1998.

TID Engineering will assist with providing construction management and inspection services to the project. The engineering firm HDR, Inc. has been retained to prepare detailed construction plans and specifications, oversee construction management, and assist with ROW easement documentation.

Project design work has been performed by McBain & Trush who will continue to provide oversight of the civil construction design work, revegetation design and implementation, and fluvial process monitoring. McBain & Trush is a professional consulting partnership specializing in applying fluvial geomorphic and ecological research to river management and restoration, particularly in regulated river ecosystems. The principals on this project are Scott McBain, Dr. William Trush, and John Bair. Scott McBain is a hydraulic engineer and fluvial geomorphologist with a MS in Civil Engineering from the University of California at Berkeley. He specializes in effects of high stream flows on channel morphology, bedload transport, watershed sediment yields, and stream restoration. Dr. William Trush is an adjunct professor in the Humboldt State University Fisheries Department, specializing in anadromous fish ecology, anadromous fish interactions with fluvial geomorphology, channel maintenance flows and hydrology, riparian ecology, and stream restoration and management. He is also Director of the HSU Institute for River Ecosystems. John Bair is a riparian botanist with a MS in Environmental Systems form Humboldt State University. He specializes in riparian interactions with geomorphic processes and riparian restoration.

The firm Stillwater Sciences has been retained to assist with the design and implementation of the fishery monitoring plan components. Stillwater Sciences is actively involved with the river wide monitoring associated the Districts' FERC Settlement Agreement.

VII. COMPLIANCE WITH STANDARD TERMS & CONDITIONS

Applicant is a public entity. The applicable RFP project group type is Group C, Public Works Construction.

The applicant agrees to the terms and conditions of the Request for Proposals dated May 1998 and as amended by CALFED's Responses to RPF Questions dated 2 June 1998, and applicant intends to comply with those terms and conditions.

It is anticipated that a majority of the public works construction effort will be performed by private contractors. The applicant will be deferring the requirement for submission of bid & payment bonds until such time as each subcontract is sought and awarded and before any work under the subcontract is performed.

Enclosed are the following completed forms:

Nondiscrimination Compliance Statement, RPF Item No. 7

Submitted by:

TURLOCK IRRIGATION DISTRICT

By ____________________
Paul D. Elias, General Manager

Date: 30 June 1998

ferc\restplan\SRP10CalFedRFP.doc

ONDISCRIMINATION COMPLIANCE STATEMENT

OMPANY NAME

Turlock Irrigation District

The company named above (hereinafter referred to as "prospective contractor") hereby certifies, unless specifically exempted, compliance with Government Code Section 12990 (a-f) and California Code of Regulations, Title 2, Division 4, Chapter 5 in matters relating to reporting requirements and the development, implementation and maintenance of a Nondiscrimination Program. Prospective contractor agrees not to unlawfully discriminate, harass or allow harassment against any employee or applicant for employment because of sex, race, color, ancestry, religious creed, national origin, disability (including HIV and AIDS), medical condition (cancer), age, marital status, denial of family and medical care leave and denial of pregnancy disability leave.

CERTIFICATION

I, the official named below, hereby swear that I am duly authorized to legally bind the prospective contractor to the above described certification. I am fully aware that this certification, executed on the date and in the county below, is made under penalty of perjury under the laws of the State of California.

OFFICIAL'S NAME Paul D. Elias	
DATE EXECUTED June 30, 1998	EXECUTED IN THE COUNTY OF Stanislaus
PROSPECTIVE CONTRACTOR'S SIGNATURE Paul Elias	
PROSPECTIVE CONTRACTOR'S TITLE General Manager	
PROSPECTIVE CONTRACTOR'S LEGAL BUSINESS NAME Turlock Irrigation District	

I-009041

Appendix 1

SRP 9 & 10 Restoration Project Proposal

TUOLUMNE RIVER CHANNEL RESTORATION PROJECT

SPECIAL RUN POOLS 9 AND 10
TUOLUMNE RIVER MILE 25.9 AND 25.4

Prepared for:

Tuolumne River Technical Advisory Committee
(Don Pedro Project, FERC License No. 2299)

July 15, 1997

Prepared by:

McBain and Trush
P.O. Box 663
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TUOLUMNE RIVER CHANNEL RESTORATION: SRP 9 AND 10

1.0 GOAL OF PROJECT

Rebuild select portions of the Tuolumne River channel into a more natural, dynamic morphology that will improve chinook salmon survival and will be in (or near) quasi-equilibrium with the contemporary hydrologic and geomorphic processes.

Objectives

1. *Reduce salmonid predator habitat.*
2. *Restore and increase salmonid habitat.*
3. *Rebuild a natural channel geometry scaled to current channel forming flows.*
4. *Restore and increase native riparian plant communities, establishing each species within the predicted hydrological niche of the contemporary hydrologic regime.*

2.0 PRELIMINARY DESIGN FOR CHANNEL GEOMETRY AND PLANFORM DIMENSIONS

2.1 Project location

This proposal targets two nearly adjacent sites on the lower Tuolumne River, one at river mile 25.9 and the other at river mile 25.4, herein named SRP (Special Run-Pool) 9 and SRP 10, respectively (Figure 1). These sites are 15 miles east of Modesto, immediately downstream of the Geer Road Bridge. These two sites are being considered as a single project for the following reasons:

1. The close proximity of the two sites make them geomorphically mutually interdependent (i.e., the design of one site will influence the other).
2. Cost effectiveness: since we propose a similar restoration strategy at both sites, the proposal/permitting/design/implementation/monitoring phases will be more manageable and economical when grouped together.

These two sites are the largest known predator isolation projects on the Tuolumne River, and thus the most expensive to restore. EA Engineering (1992) has found bass predation outmigrating salmon smolts to be a significant limiting factor on their populations. Nearly all salmon spawning in the Tuolumne River occurs upstream of this location so that most juveniles must pass through this reach.

2.2 Channel geometry and planform dimensions

The regulation of flow and the reduction of sediment supply in the Tuolumne River by dams have changed the geometry of the channel from its pre-dam configuration, creating a new bankfull channel and riparian stand structure. The Tuolumne River channel has been further manipulated by agricultural practices (channelization and rip-rap), gold dredging (fragmentation, channelization, relocation), flood control (channelization and rip-rap), and aggregate extraction (channelization, creation of abnormally large pools, degradation) nearly over its entire length, limiting the number of "model" reaches where post-dam channel geometry has been allowed to adjust naturally. One of these few model reaches is found between river mile 35.0 to 35.6, and several cross sections, a thalweg profile, and a planform map of thalweg location were recorded at that site by Trinity Fisheries Consulting in 1990 (Figures 2 and 3). Their measurements have provided an initial estimate of post-dam channel morphology that is used in this proposal to prepare the following initial design channel dimensions (Figures 4 and 5):

appx channel width at low water	50 - 100 feet
appx channel depth at low water	0 - 2 feet
appx width at spawning flow (300-500 cfs)	100 - 115 feet
appx ave channel depth at spawning flow	1 - 2 feet
appx ave water velocity at spawning flow	1.3 - 2.5 feet/sec
appx bankfull width	175-200 feet
appx ave bankfull depth	7 feet
appx ave bankfull water velocity	4.4 feet/sec
appx floodplain width	> 300 feet
max floodway width, including terrace	< 650 feet
maximum design floodway discharge	15,000 cfs
appx meander wavelength	1,200 - 1,600 feet
appx sinuosity	1.1-1.2
appx radius of curvature	380 feet

The bankfull channel in this model reach was not well-defined. Additional field data will be collected at this model reach (as well as others), and integrated with hydraulic modeling techniques to refine a design channel morphology.

2.3 SRP 9 Channel Design

Aggregate mining at the SRP 9 site created a 400 ft wide by 6-19 ft deep hole in the river (Figure 6). Levees that isolated the habitat of fish that predate on juvenile salmonids from the main river was evaluated, but this treatment required nearly as much material as that required to simply rebuild a complete floodplain. Therefore, restoring a functional floodplain is the proposed treatment, and would require approximately 146,000 yd^3 of fill (Figure 7 and 8).

The topography between SRP 9 and 10 has not been measured, thus incorporating this short section into the design will be done during the detailed design phase. A preliminary estimate of 3,500 yd^3 will be required to fill the small undulations in channel planform between SRP 9 and 10.

2.4 SRP 10 Channel Design

A larger amount of aggregate extraction occurred at SRP 10 compared to SRP 9, creating a 300-400 ft wide by 10-36 ft deep hole in the river (Figure 6). Two restoration alternatives were evaluated because of the immense volume of fill required to restore the channel to a pre-mining configuration. Again, an alternative of isolating much of the deeper portions by levees was evaluated. Although that alternative requires less fill material and satisfies the objective of reducing bass predator habitat, it only partially satisfies the overall goal of rebuilding a more natural river and riparian community. The proposed design (Figures 7 and 8) restores the approximate pre-mining configuration and more adequately satisfies the overall goal and objectives for the project. Furthermore, since this design proposes to fill the entire pit, it does not require a levee would need future maintenance. The approximate net fill required is 290,000 yd^3.

3.0 PRELIMINARY ENGINEERING COMPUTATIONS

3.1 Evaluating the Design Bankfull Discharge

The dimensions of an undisturbed river are a function of its history of flow and sediment input. This is only partially true for regulated streams, because the channel is often in a state of transition from pre- to post- regulation morphology or, if regulated flows are too low to permit significant sediment transport, the channel can permanently retain remnants of the pre-dam morphology. The Tuolumne River combines both of these. Bankfull discharge has been found to closely correlate with the discharge most influential in forming the channel, and as such, is commonly used by river engineers as a design discharge. Bankfull discharge just begins to spill onto the floodplain, and over time, the bankfull discharge tends to transport more sediment than larger but less frequent floods.

The bankfull channel strongly influences bedload transport in the main channel. In many alluvial rivers, bedload begins to move at discharges slightly less than bankfull; as the discharge increases to bankfull discharge, bedload is transported at a significant rate. Once bankfull discharge is exceeded, the flow spills onto the floodplain and minimizes the rate of increase in boundary shear stress (and thus, bedload transport).

Quantifying bankfull discharge on the Tuolumne River is problematic, because channel-forming flows are based less on precipitation-induced floods, and more as a result of power generation and controlled flood releases. The maximum power generation releases (4,500 to 5,500 cfs) occur frequently, which may imply a post-dam channel forming flow, but have little to no bedload transport capacity based on tracer gravel experiments at 5,400 cfs. Therefore, the channel geometry at the site will need to be designed to transport bedload at the design bankfull discharge. In many streams, bankfull discharge has been found to have a recurrence interval (RI) in the annual maximum series between 1.5 and 2.0 years (Leopold 1994). The post-dam 1.5- and 2-year RI flood for the Tuolumne River at Modesto gaging station is 3,900 cfs and 4,300 cfs respectively. The bankfull channel indicators at the single model site need more analysis, so evaluating the 1.5- to 2.0-year flood as a bankfull discharge by comparing it with bankfull channels measured in the field will require more detailed field work. In the meantime, a contemporary bankfull discharge of approximately 4,000 cfs is assumed, since it falls within the 1.5 and 2.0 year flood and allows preliminary design development, which will be refined as more field data is collected.

The design bankfull channel as proposed in section 2.2 must convey the bankfull discharge. The following analysis evaluates the channel conveyance by using a simple Manning's analysis. Prior work by Trinity Fisheries Consulting (1990) found that the bed slope from river mile (RM) 34 to RM 37.5 is 0.0015; field measurements by EA personnel during the 1995 high flows (approximately 6,000 cfs) found water surface slopes of 0.00075 near the project site. Because both the Manning's analysis and bed mobility models (see section 3.2 below) are very sensitive to slope and the low slopes of the Tuolumne River are difficult to measure accurately, a range of discharge estimates were bracketed using both slope values. A Manning's roughness of 0.035 was used for discharges less than or equal to bankfull discharge. For a slope of 0.0015, the estimated bankfull discharge is 4,100 cfs, and for a slope of 0.00075, the estimated bankfull discharge is 2,900 cfs.

3.2 Bed mobility

As stated in section 3.1, bankfull discharge should transport more of the total sediment load over time than other discharges. Therefore, a minimum criterion for bankfull discharge is to mobilize sediments represented in the bed surface. The D_{84} particle size (the particle size of which 84 percent of the bed surface is finer) forms the structural component of the bed surface, and should be transportable at bankfull discharge. Therefore, it is a useful test of the channel design to apply bed mobility models to predict the particle size moved by the estimated bankfull discharge of 4,000 cfs within the design bankfull channel.

For long, straight flume-like reaches, the shear stress (τ_b) on the bed surface can be approximated by $\tau_b = \rho_w gRS$, where ρ_w=density of water (1.0 g/cm^3), g=gravitational acceleration (980 cm/s), R = hydraulic radius (approximately equal to the average water depth), and S=energy slope (approximately equal to the water surface slope). Andrews (1983) and others, using Shields equation (Equation 1 and 2), found that the dimensionless critical shear stress (τ^*_c) for the larger particles in a given particle size distribution is nearly 0.02, which has been corroborated by field measurements on the Trinity River by McBain and Trush (1995).

$$\tau^*_{ci} = \frac{\tau_b}{(\rho_s - \rho_w)gD_i} = \frac{\rho_w gRS}{(\rho_s - \rho_w)gD_i} \approx \frac{RS}{1.65D_i} \qquad (1)$$

where ρ_s=density of sediment (2.65 g/cm^3) and Di=particle size of interest in centimeters. Solving for Di,

$$D_i = \frac{RS}{1.65\tau^*_{ci}} \qquad (2)$$

equation 2 predicts the particle size moved for a given depth, slope, and dimensionless critical shear stress. Assuming τ^*_{cD84}=0.02, the predicted D_{84} particle that would be at incipient motion during a bankfull discharge is 97 mm for a slope of 0.0015 (slope as measured by Trinity Fisheries

Consulting, 1990), and 48 mm for a slope of 0.00075 (slope as measured by EA personnel in 1995). We currently do not have bed particle size data near the project site, so we cannot compare this incipient motion particle size to the on-site particle size distribution. The 97 mm and 48 mm particles are well represented in the particle size distributions at the Trinity Fisheries Consultants study sites (near RM 35), but the particle sizes down-river at the location of the project site may be smaller (due to lower slope). The particle size distribution of the bedload supply, thus the material that sizes the future bed surface, will need to be well documented at the project site before finalizing the design. The incipient motion of a 97 mm particle using a slope of 0.0015 represents the "worst case scenario" for excessive particle mobility, and if the true bankfull slope is 0.00075, then a 97 mm rock would have greatly restricted mobility.

3.3 Bank Stability and Riparian Revegetation

In section 3.2, the bed mobility model predicts that a 97 mm particle on the bed surface will mobilize at bankfull discharge or greater for a slope of 0.0015. However, the simplifying assumptions needed to apply Equations 1 and 2 cannot be made for shear stress on banks. Bank erosion on long, straight flume-like reaches is minimal because of energy diffusion from the bank margins, shallow water depths near the banks, and large bank material particle sizes. In contrast, fluid forces on the banks on the outside of a meander bend will be greater than in a long, straight flume-like reach, and increase with increasing radius of curvature. A small degree of bank erosion and channel migration is part of the natural processes that most alluvial rivers exhibit, but rapid channel evulsion or excessive migration of a newly constructed channel is undesirable.

Riparian vegetation in undisturbed alluvial channels often impedes channel migration. Root and stem strength increases the cohesiveness of banks, particularly those composed of non-cohesive sediments. Over time, bank and vegetation are slowly eroded on the outside of meander bends and new vegetation colonizes the extending point bar. Therefore, the revegetation design is a crucial component of the overall channel restoration design. More intensive revegetation with live willow rootwads at the outside of meanders will provide immediate bank protection and increase the regrowth success in these critical areas. As shown on Figures 4, 5, and 7, and Table 1, the proposed design would establish riparian species at the proper inundated surfaces within the hydraulic geometry and planform of the channel.

Table 1. Generalized riparian revegetation plan corresponding to hydraulic geometry of reconstructed channel.

Species	Channel features	Discharge range
Sedges	low water to spawning flows	10 to 500 cfs
Sandbar willow	low water to bankfull	10 to 4,000 cfs
Alder/box elder	slightly below bankfull	2,500 to 4,000 cfs
Red willow	slightly below bankfull to slightly above	2,500 to 6,000 cfs
Cottonwoods	above bankfull on floodplain	above 4,000 cfs
Gooding willow	above bankfull on floodplain	above 4,000 cfs
Valley Oaks	above floodplain on terraces	7,000 to 15,000 cfs

4.0 PERMITTING CONSIDERATIONS

Restoration projects the size of SRP 9 and 10 will require permits from several State and Federal agencies. Permits for these projects will require compliance with the California Environmental Quality Act (CEQA) for state permits and National Environmental Protection Act (NEPA) for federal permits. The Lead Agency may elect to prepare a Negative Declaration under CEQA and seek a Finding of No Significant Impact (FONSI) under NEPA because these projects seek to restore the environmental quality of the Tuolumne River. Many, if not all, of the following determinations and permits may be required to implement this project:

1. State Lands Commission:
   Boundary Delineation; Non-Prejudicial Determination

2. California Department of Fish and Game:
   Section 1600 Streambed Alteration Agreement; Section 2081
   California Endangered Species Act

3. California Department of Water Resources-Reclamation Board:
   Encroachment Permit

4. California Regional Water Quality Control Board:
   Porter-Cologne Act; Section 208 Discharge Permit

5. United States Army Corps of Engineers:
   Wetlands-Water of the US Delineation;
   Clean Water Act Section 404 Fill and Dredge Permit

5.0 MONITORING

The monitoring phase of any project must focus first on whether the project objectives have been satisfied. Have predator habitat, predator population, and salmonid predation rates been reduced?

Has salmonid habitat been improved? How has a certain flood affected channel morphology? How successful is the riparian revegetation, and how has it contributed to channel stability? Quantitative monitoring techniques are a crucial part of any restoration project to answer these important questions.

5.1 FISH HABITAT AND USE MONITORING

The proposed restoration design will restore important salmon spawning and rearing habitat within the SRP 9 and 10 reach, and reduce salmonid predator habitat created by the aggregate extraction. Fish habitat and use monitoring will focus on documenting the effect of the project on: 1) pre- and post-project salmonid predator habitat availability (preferred water surface area, depth, and velocity), 2) pre- and post-project salmonid predator populations, and 3) pre- and post-project salmonid predation rates. While direct quantification of actual salmonid predation is preferable, quantitative description, accuracy, precision, and cost becomes increasingly difficult from 1) to 3). Therefore, pre- and post-project predator habitat will be sketched onto topographical maps (created from the pre-project and as-built topographic surveys, and pre- and post-project predator populations will be estimated during the following periods:

- 1 year prior to construction (if funding is available)
- immediately prior to construction
- 1 month after construction (allowing predators to migrate back into site)
- once a year for each of the next three years after construction to document long-term trend

In addition, a control site will be established and monitored similarly to the project site to estimate population trends that may be independent of the project. For example, if predator populations are reduced as a result of the project, and a nearby undisturbed control site shows a similar downward trend, then the real effect of the project on predator populations can be evaluated by comparing the two sites. Because documenting actual salmonid predation rates is difficult and potentially inaccurate, a monitoring strategy to better document this variable is being developed by the Tuolumne River Settlement Agreement Technical Advisory Committee, and may be used at the SRP 9 and 10 sites.

5.2 CHANNEL MORPHOLOGY

The key to monitoring changes in channel morphology is to sample prior to and after flow events capable of causing a change in morphology. Sampling based on a pre-determined schedule can often measure a non-changing variable if, for example, the watershed is experiencing a drought and no bedload sized sediments are being transported. The discharge of a threshold event that begins to transport the most mobile of gravel-sized bed deposits must be quantified, then develop our channel morphology monitoring plan to sample after each of four threshold events. We will then be guaranteed to collect meaningful data whereby channel response can be determined and evaluated, which we can use to improve future designs.

A digital terrain model of the two sites will be constructed in the initial phase of the project, providing three-dimensional pre-project site topography. These sites will be resurveyed (again in three dimensions) immediately after one large flood event (greater than 8,000 cfs) to evaluate changes in channel morphology. The three dimensional survey offers the advantage of accurate volumetric analysis and total site coverage, which makes the assessment of cause-and-effect channel responses much easier. However, smaller flood events (4,000 cfs to 7,500 cfs) would not cause large scale morphological change, thus repeat cross sectional surveys would suffice. Three dimensional topography would be obtained by total station surveying, while cross sections would be surveyed by using an engineers level. If less than two threshold events (estimated as greater than 4,000 cfs) have occurred after 5 years, cross sectional surveys will be done, concluding the channel morphology monitoring component of the project.

5.3 RIPARIAN REVEGETATION

Riparian monitoring would target two main considerations: the success of the revegetation effort, and the stabilization benefit of riparian vegetation on channel morphology. Quantifying the former would include plots at different locations and elevations within the planform (e.g., heads of bars, near low water, floodplain, outside of bends), while the latter would measure bank erosion at differing locations on meander bends and compare differing revegetation treatment schemes. Design factors such as radius of curvature, particle size, and other strongly influence the forces on the riparian plants on the outside of meander bends, thus our monitoring plan should be robust enough to detect and evaluate these factors. We propose the following monitoring schedule:

Time after revegetation	Monitoring Objective
0 (winter)	Establish plots, document initial conditions
8 months (pre-winter)	Document over-summer survival
16 months (pre-summer)	Document over-winter/pre-summer survival
first flood > 4,000 cfs	Document scour/inundation mortality in plots and on meander bends
first flood > 8,000 cfs	Document scour/inundation mortality in plots and on meander bends

2 consecutive drought years	Document drought related mortality
5 years	Document overall survival, conclude monitoring program

Yearly monitoring reports will be produced, and at the end of the five year monitoring program, a final monitoring report will be produced that summarizes monitoring data, and more importantly, interprets the data and makes recommendations that will improve future designs.

6.0 SUMMARY

This analysis is based on data from 1989-1991 field work done by Trinity Fisheries Consulting, depth soundings by EA personnel on 20-23 December 1993, water slope data collected by EA personnel on June 15, 1995, tracer gravel observations made by McBain and Trush in 1996, and other varied field efforts. Preparation of the final design will include more in-depth data collection and analysis of model reach morphology, bed mobility, and riparian communities than are presented here. This in-depth data collection is presently being conducted outside of this proposal at the direction of the Tuolumne River Settlement Agreement Technical Advisory Committee, and includes:

- testing the validity of bankfull discharge/channel forming discharge concepts on a regulated river;
- calibrating hydraulic models to the latest high flow releases (water surface slopes, Manning's roughness in gravel and vegetated portions of the channel, etc.);
- estimating meander wavelength, amplitude, radius of curvature, and bar slopes;
- assessing native species composition and distribution of riparian vegetation within the Tuolumne River corridor.

7.0 REFERENCES

Andrews, E.D., (1983). Entrainment of gravel from naturally sorted riverbed material. *GSA Bulletin*, Vol. 94, p. 1225-1231.

EA Engineering, Science, and Technology, (1992). Lower Tuolumne River predation study report, in *Appendix 22 of Volume 7 Report of Turlock Irrigation District and Modesto Irrigation District Pursuant to Article 39 of the License for the Don Pedro Project.*

Leopold, L.B. (1994). *A View of the River*, Harvard University Press, Cambridge, 298 p.

McBain, S.M. and Trush, W.J. (1995). Channelbed mobility and scour on a regulated gravel-bed river, In *ASCE Waterpower '95 Proceedings*, San Francisco, CA, July 1995.

Trinity Fisheries Consulting, (1990). Miscellaneous fieldbook data.

Figure 1. SRP 9 and 10 project location map.

Figure 2. One of several model cross sections in undisturbed reach (Tuolumne River mile 35.5) used to develop design cross sections.

Figure 3. Model reach planform and thalweg profile from Tuolumne River mile 34.7 to 35.6 Elevations reference 1929 USGS datum.

Figure 4. Generalized riffle cross section showing proposed channel dimensions and riparian revegetation schemes.

Figure 5. Generalized pool cross section showing proposed channel dimensions and riparian revegetation schemes.

Figure 6. SRP 9 and 10 existing contour map based on 1994 depth soundings. Elevations are based on arbitrary datum, where low water elevation assigned elevation of 100'.

Figure 7. SRP 9 and 10 proposed contour map. Elevations are based on arbitrary datum, where low water elevation assigned elevation of 100'.

Figure 8. SRP 9 and 10 proposed three-dimensional view. Elevations are based on arbitrary datum, where low water elevation assigned elevation of 100'.

SRP 9 and 10 ESTIMATED BUDGET-6/24/97

SRP 10 design and permitting included as part of SRP 9

SRP 9

Determine site specific design channel dimensions for SRP 9 and 10

LABOR	PER DIEM, MATERIALS, EQUIPMENT RENTAL	SUBTOTAL
$14,450	$1,950	**$16,400**

Topographic survey of SRP 9 and SRP 10

LABOR	PER DIEM, MATERIALS, EQUIPMENT RENTAL	SUBTOTAL
$17,400	$1,535	**$18,935**

Write final design, revisions for SRP 9 and SRP 10

LABOR	PER DIEM, MATERIALS, EQUIPMENT RENTAL	SUBTOTAL
$41,050	$2,055	**$43,105**

Project permitting for SRP 9 and 10

LABOR	PER DIEM, MATERIALS, EQUIPMENT RENTAL	SUBTOTAL
$41,250	$4,813	**$46,063**

Field stakeout (SRP 9 ONLY)

LABOR	PER DIEM, MATERIALS, EQUIPMENT RENTAL	SUBTOTAL
$4,525	$613	**$5,137.50**

Construction, assuming 100 loads/day (SRP 9 ONLY)

	CU YDS	COST/YD	TOTAL	
FILL MATERIAL	146,000	$0	$0	
SPAWNING MATERIAL	12,000	$8	$96,000	
[redacted]				
	CU YDS	COST/YD		Trucking total
TRUCKING (reasonable)	146,000	$8		$1,168,000
	DAYS	RATE	TOTAL	
2 D9'S on-site	150	$1000/day	$300,000	
Excavator at LaGrange	75	$1000/day	$150,000	
Site Preparation (pave SRP 9&10 and LaGrange access, improve access road drainage)				$200,000
			Construction Subtotal:	**$1,914,000**

Construction supervision (SRP 9 ONLY)

LABOR	PER DIEM, MATERIALS, EQUIPMENT RENTAL	SUBTOTAL
$18,575	$1,913	**$20,487.50**

Riparian revegetation (SRP 9 ONLY)

LABOR	PER DIEM, MATERIALS, EQUIPMENT RENTAL	SUBTOTAL
$97,969	$19,132	**$117,101**

Channel, predator, and riparian monitoring (SRP 9 ONLY)

LABOR	PER DIEM, MATERIALS, EQUIPMENT RENTAL	SUBTOTAL
$66,500	$8,925	**$75,425**

SRP 9 SUBTOTAL:	**$2,256,653**
Project Administration (10% of non-construction budget):	**$34,265**
Contingency (10% of entire budget):	**$225,665**
SRP 9 GRAND TOTAL:	**$2,516,584**

Draft 7/15/97

SRP 10

Determine site specific design channel dimensions for SRP 10 (INCLUDED IN SRP 9 BUDGET)

Topographic survey of SRP 9 and SRP 10 (INCLUDED IN SRP 9 BUDGET)

Write final design, revisions for SRP 9 and SRP 10 (INCLUDED IN SRP 9 BUDGET)

Project permitting for SRP 9 and 10 (INCLUDED IN SRP 9 BUDGET)

Field stakeout (SRP 10 ONLY)

LABOR	PER DIEM, MATERIALS, EQUIPMENT RENTAL	SUBTOTAL
$4,525	$613	**$5,138**

Construction, assuming 100 loads/day (SRP 10 ONLY)

	CU YDS	COST/YD	TOTAL	
FILL MATERIAL	293,000	$0	$0	
SPAWNING MATERIAL	12,000	$8	$96,000	
[redacted]				
	CU YDS	COST/YD		Trucking total
TRUCKING (reasonable)	293,000	$8		$2,344,000
	DAYS	RATE	TOTAL	
2 D9'S on-site	195	$1000/day	$390,667	
Excavator at LaGrange	75	$1000/day	$150,000	

Construction Subtotal: $2,980,667

Construction supervision (SRP 10 ONLY)

LABOR	PER DIEM, MATERIALS, EQUIPMENT RENTAL	SUBTOTAL
$18,575	$1,913	**$20,488**

Riparian revegetation (SRP 10 ONLY)

LABOR	PER DIEM, MATERIALS, EQUIPMENT RENTAL	SUBTOTAL
$195,938	$38,264	**$234,201**

Channel, predator, and riparian monitoring (SRP 10 ONLY)

LABOR	PER DIEM, MATERIALS, EQUIPMENT RENTAL	SUBTOTAL
$66,500	$8,925	$75,425

SRP 10 SUBTOTAL:	**$3,315,918**
Project Administration (10% of non-construction budget):	**$33,525**
Contingency (10% of entire budget):	**$331,592**
SRP 10 GRAND TOTAL:	**$3,681,035**

Draft 7/15/97

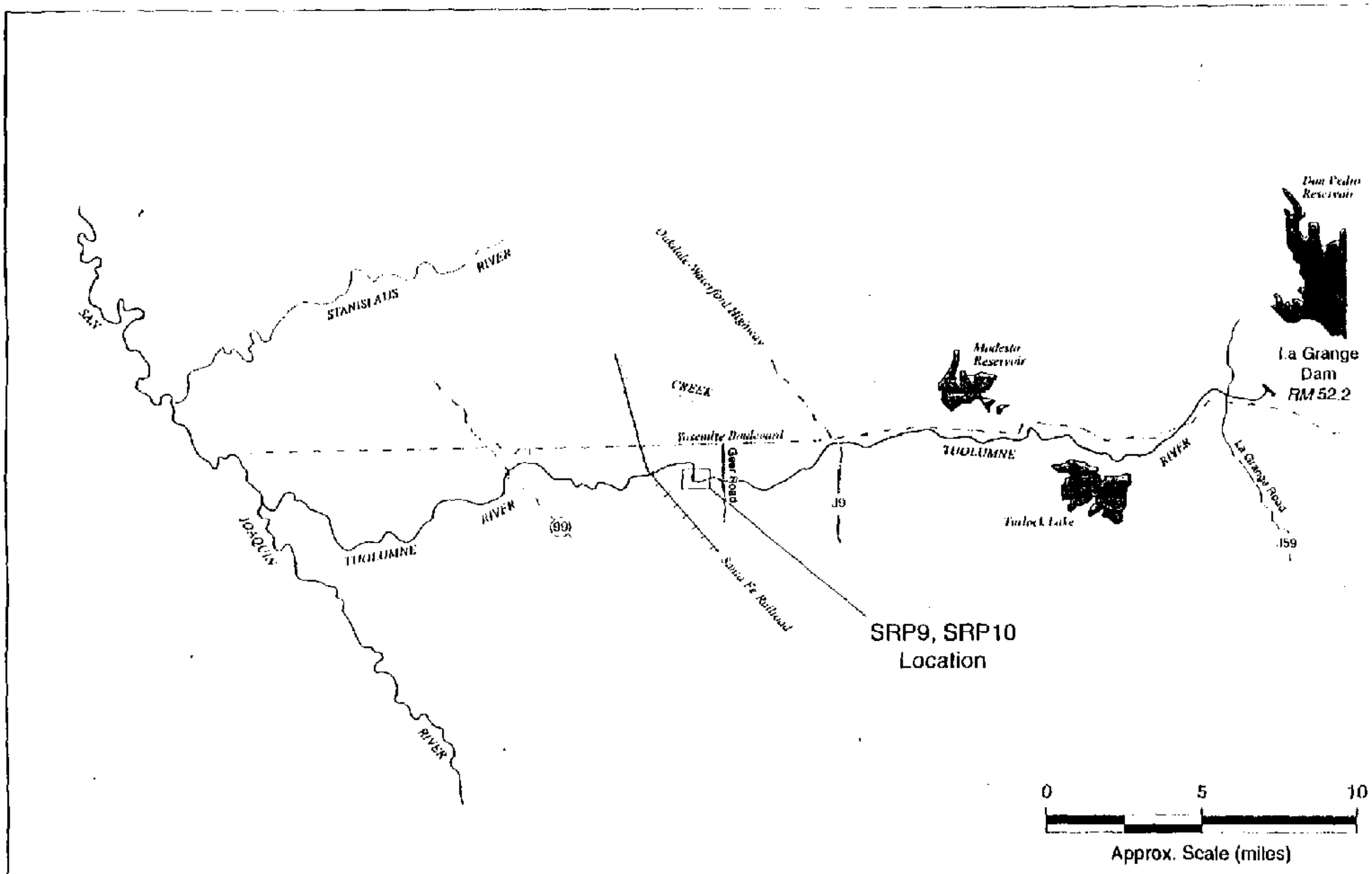
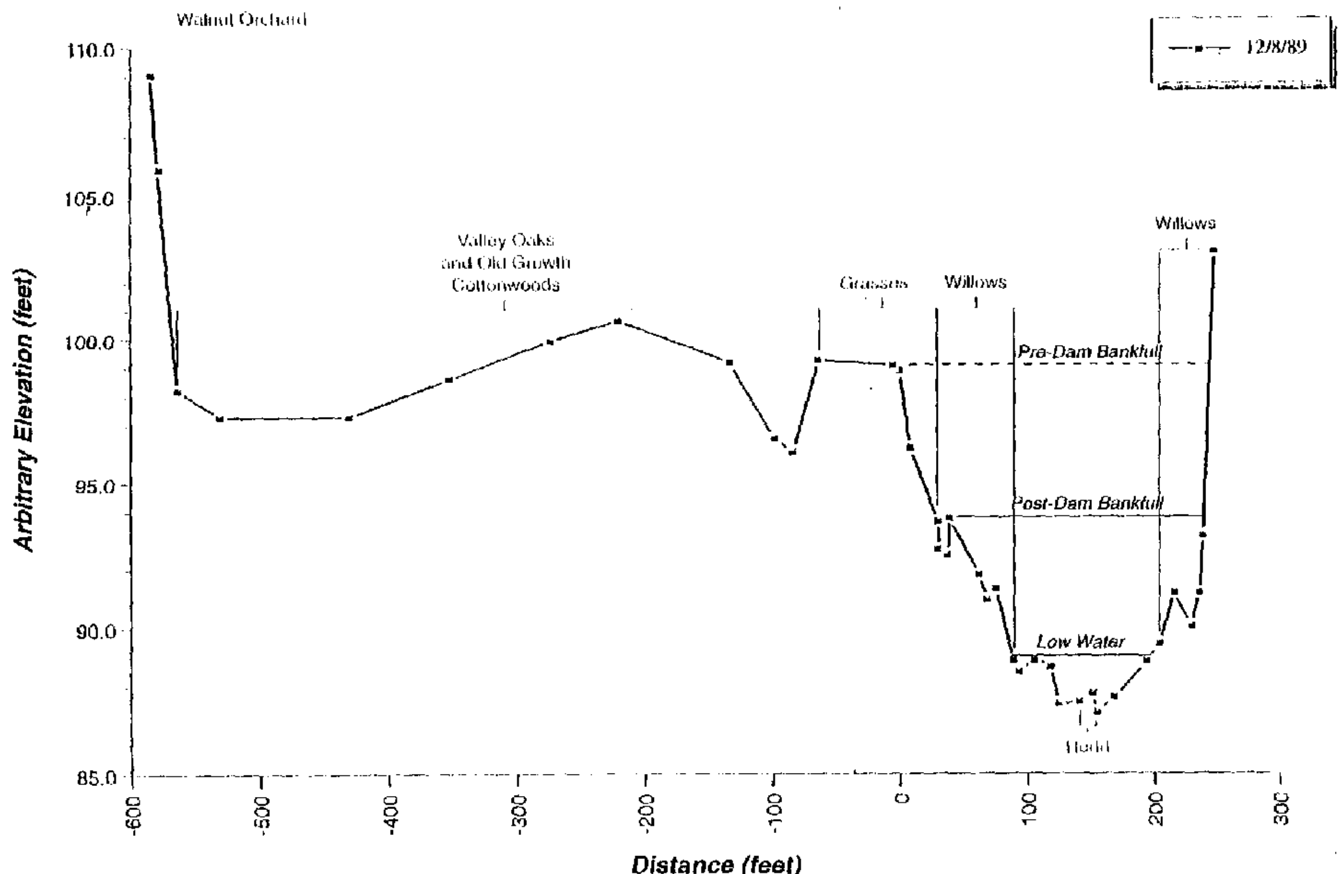


Figure 1. Locations of SRP9 and SRP10 floodway restoration sites,

EA Engineering, Science, and Technology

I-009056



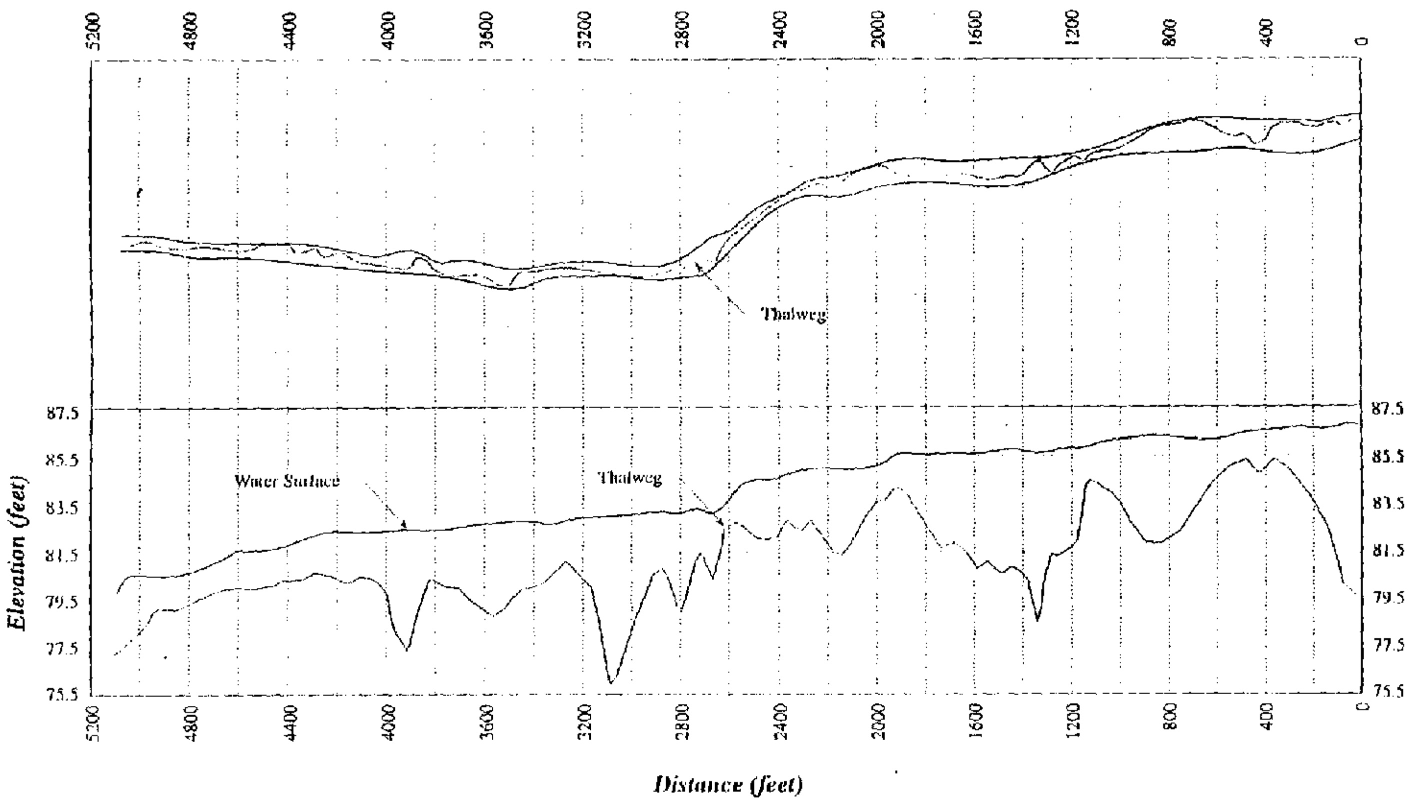
From Trinity Fisheries Consulting, 1989.

Figure 2. One of several model cross-sections in an undisturbed reach (Tuolumne River mile 35.5) used to develop design cross-sections.

EA Engineering, Science, and Technology

PROJECT NO. 13009.01.2000 DATE 8/9/95

I-009057

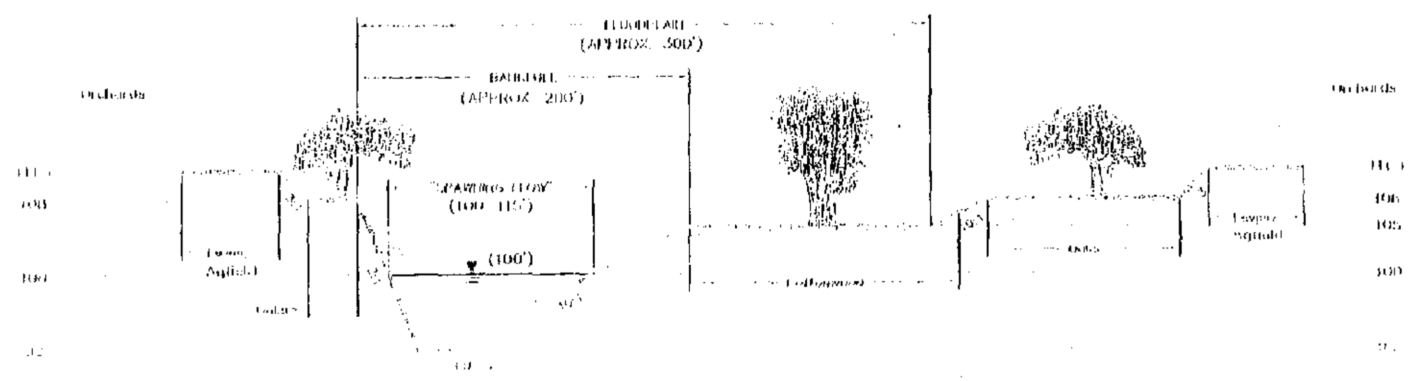


From Trinity Fisheries Consulting, 1991.

Figure 3. Model reach planform and thalweg profile from Tuolumne River mile 34.7 to 35.6. Elevations reference 1929 USGS datum.

EA Engineering, Science, and Technology

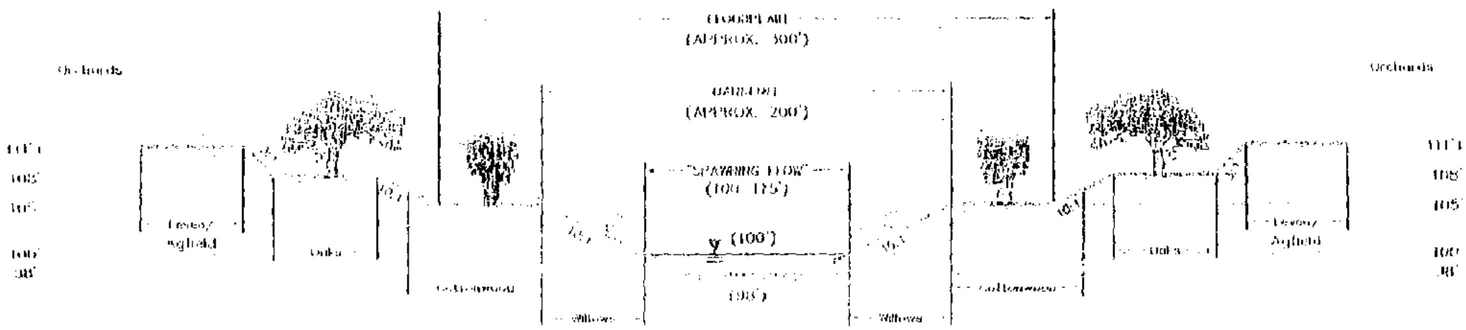
PROJECT NO. 13009.01.2000	DATE 8/9/95	
FILE NAME: GR2.FH3	REVIEWED BY: F. Ligon	DRAWN BY: M. Wollrich



NOTES:
SIDE SLOPE: Horizontal:Vertical
ELEVATION: Arbitrary Datum
5X Vertical Exaggeration

EA ENGINEERING, SCIENCE, AND TECHNOLOGY

Figure 5. Conceptual Design Cross Section Through

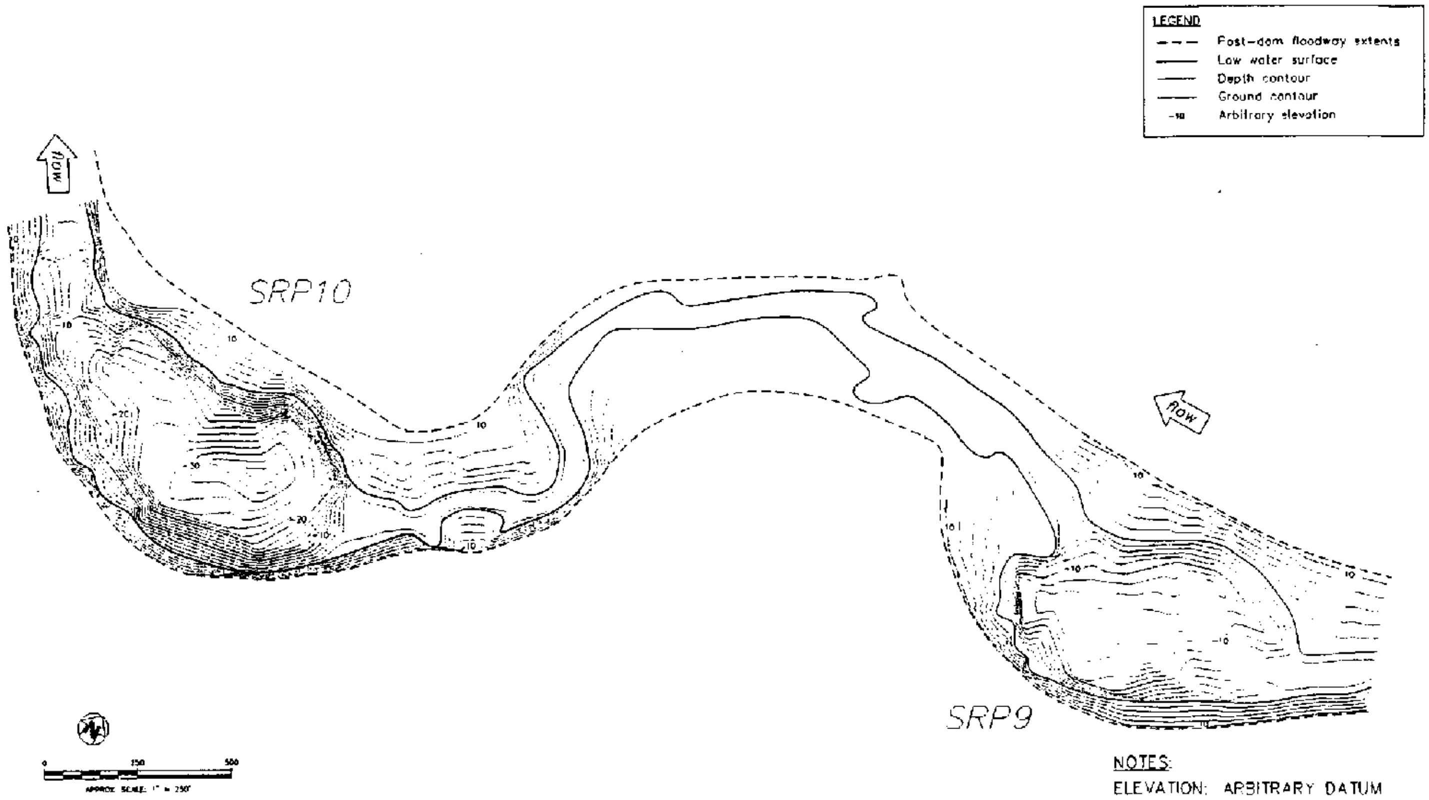


NOTES
SIDE SLOPE: Horizontal Vertical
ELEVATION: Arbitrary Datum
5X Vertical Exaggeration

Figure 1 Conceptual Design Cross Section through riffle (alternate bar crossover)

EA ENGINEERING, SCIENCE, AND TECHNOLOGY

PROJECT NO: 13009.01.2000	DATE: 7/25/95



NOTES:
ELEVATION: ARBITRARY DATUM

Figure 6. SRP9-10 – Existing Topography.

EA ENGINEERING, SCIENCE, AND TECHNOLOGY

13009 01.2000	8/9/95

S9-10 DWG	F. Ligon	M. Wolfrich

I-009061

I-009062

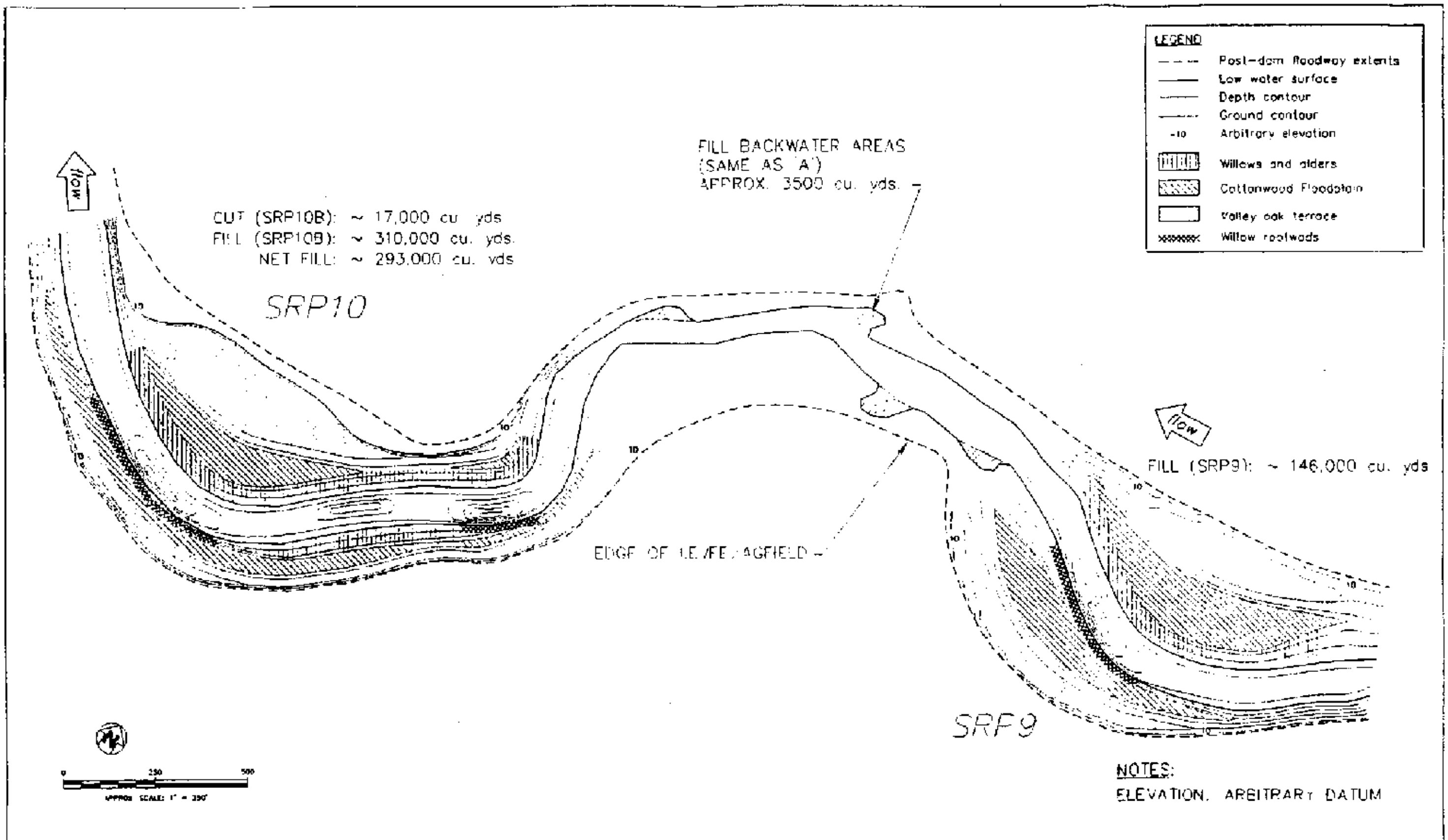


Figure 7. SRP9–10 – Design 'B'.

EA ENGINEERING, SCIENCE, AND TECHNOLOGY

13009.01.2000	8/?/95
S9-10.DWG	F. Ligon
M. Wolfrich	

I-009062

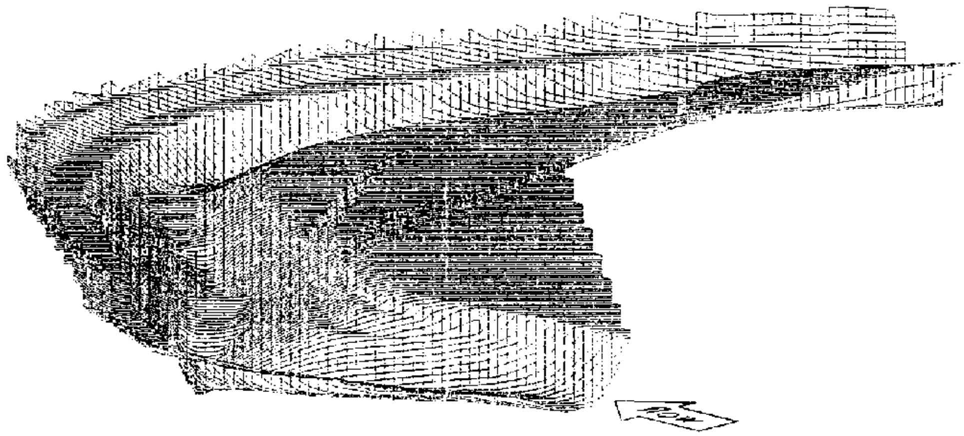


Figure 8 SRP10 Design 'B' 3D Model.

EA ENGINEERING, SCIENCE, AND TECHNOLOGY	
13009.01.2000	7/5/95
SRP10-B.DWG	F. Ligon

Appendix 2

SRP 9 & 10 Reach Monitoring Plan

Sections 1.0 and 2.0 from Attachment D of the
draft project EA/IS dated 15 May 98

Attachment D
Draft Monitoring Plan

Anadromous Fish Restoration Program
Tuolumne River Riparian Zone Improvements

Gravel Mining Reach & Special Run Pools 9/10 Restoration and Mitigation Projects

Sacramento Field Office
United States Fish and Wildlife Service
Sacramento, California

Turlock Irrigation District
Turlock, California

May 15, 1998

I-009064

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Table

1 Monitoring Schedule Based on a Sequence of Hypothesized Peak Flows and Tentative Construction Implementation Schedule 3

1.0 Purpose

This Monitoring Plan describes methods to evaluate the SRP 9, SRP 10, and Gravel Mining Reach restoration and mitigation projects on the Tuolumne River. The Plan recommends monitoring objectives and proposes field techniques, data management and analysis protocols, budget and funding needs, and an example timeline for implementing the Monitoring Plan. The Plan is a culmination of ideas and efforts originally formulated by the Monitoring Subcommittee of the Tuolumne River Technical Advisory Committee (TRTAC) and is provided to accompany the EA/IS and permit applications for the restoration and mitigation projects. Several important issues were considered when selecting the proposed monitoring protocols, including: 1) how to interpret the effectiveness of specific restoration actions; 2) appropriate target species and life stages capable of elucidating expected population responses; 3) integrating project-specific monitoring proposals into existing river-wide programs or other requirements with similar objectives or methods; 4) specific requirements of environmental permits and mitigation monitoring; and 5) funding source requirements.

The Monitoring Plan is designed to evaluate two important aspects of the restoration and mitigation projects: first, to test whether stated project objectives have been met, and to guide future restoration design (project performance), and second, to evaluate success of the mitigation measures (mitigation success) and reduce significant impacts of the projects. Project performance monitoring is organized into resource issues as discussed in the accompanying EA/IS. Where possible, the restoration objectives and associated hypotheses for each section were stated with enough specificity that they could be related to the proposed monitoring objectives. Because some of the hypothesized benefits of the restoration and mitigation projects are predicated on assumptions of salmonid limiting factors (e.g., bass predation), testing specific hypotheses in the monitoring phase of these projects is proposed. Using a hypothesis-based approach for some aspects of the monitoring program, information that will guide future project design and selection (adaptive management) will be generated.

The Monitoring Plan attempts to meet CEQA/NEPA requirements, and integrate with the FERC Settlement Agreement (FSA), the CVPIA-AFRP and Comprehensive Assessment and Monitoring Program (CAMP), and the CALFED program. Monitoring data will be collected and analyzed according to standardized techniques and stored in a common database. The data will be reviewed by technical personnel and published annually in reports submitted to resource and funding agencies, and will emphasize data interpretation and adaptive recommendations. Because some of the monitoring approaches are considered experimental, modification of technique or approach may occur after the first year, especially for some of the fisheries approaches that are proposed.

The restoration and mitigation projects are scheduled for implementation over several years, beginning in summer of 1998 and continuing through 2002 (assuming all future funding needs are provided). The Monitoring Plan assumes implementation of the projects will follow the proposed schedule, but can be adapted to changes in the implementation schedule. Because the reconstructed channel morphology may respond to high discharge events by adjusting channel dimensions, several geomorphic monitoring protocols are triggered by exceedence of discharge thresholds. Field experience in 1987-1992 on the Tuolumne River showed that geomorphic monitoring during drought years (or years without significant flow events) is unnecessary, as limited useful data are collected. Therefore, geomorphic monitoring is designed to evaluate up to three peak flow events, preferably within three different discharge ranges, as a way to guarantee that meaningful data will be collected. The threshold discharge corresponds to the design bankfull discharge, initially assumed at 5,000 cfs. This discharge may occur in any given year, so to illustrate a potential monitoring schedule, an example annual peak discharge has been assigned to each future year, and then monitoring responses were linked to these threshold events. For example, in 2003 the hypothesized peak discharge of 10,400 cfs follows two dry years and triggers numerous geomorphic monitoring elements, but these elements will have been monitored in previous years if peak discharge exceeds the threshold. The third example threshold event occurs in 2005, so budget outlays and scheduling timelines for geomorphic monitoring are projected through 2005, but would be prolonged beyond 2005 in the absence of threshold-exceeding flows. Revegetated riparian zones will be monitored for 5 years following each construction phase. There is no guarantee, however, that desired flow events will occur as hypothesized in this Monitoring Plan. No artificial flow releases will be made to create conditions for such monitoring. Table 1 shows the assumed schedule for proposed project implementation, and the proposed monitoring components for each year for geomorphology, fisheries, and riparian issues.

Annual funding requirements were estimated by determining the monitoring required after each example water year, and then estimating time and expenses to conduct that monitoring. The budget allocates funding based on the assumption that all monitoring components would be implemented, but not necessarily in the example year. While wet years require more funds than dry years due to additional monitoring tasks, the average annual cost estimated through 2007 is approximately $102,000 per year. Budget estimates are based on prevailing labor rates, and time estimates based on our monitoring experience on similar projects, and assume no inflation. Costs for each monitoring component were estimated independent of other activities, but would be reduced by coordinating monitoring activities (for example, monitoring geomorphic and riparian cross sections together, etc).

I-009068

Table 2. Estimated costs associated with the hypothesized monitoring schedule. The budget assumes all monitoring components are implemented as described in the schedule.

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	TOTAL
SRP 9 and 10											
Geomorphic Processes	$1,563	$3,480	$20,880	$0	$0	$19,530	$15,610	$3,920	$0	$0	$64,983
Fisheries Resources	$75,670	$56,415	$58,515	$51,060	$4,200	$2,100	$0	$0	$0	$0	$247,960
Riparian Resources	$0	$8,145	$0	$16,290	$8,145	$8,145	$16,290	$0	$8,145	$0	$65,160
SRP 9 AND 10 SUBTOTAL	$77,233	$68,040	$79,395	$67,350	$12,345	$29,775	$31,900	$3,920	$8,145	$0	$378,103
GRAVEL MINING REACH											
Geomorphic Processes	$1,563	$6,690	$31,815	$8,000	$8,655	$107,225	$71,065	$53,525	$0	$0	$288,538
Fisheries Resources	$5,355	$14,910	$17,010	$19,110	$18,960	$9,405	$4,200	$2,100	$0	$0	$91,050
Riparian Resources	$0	$9,625	$11,805	$18,900	$27,875	$21,570	$22,170	$29,755	$10,415	$9,625	$161,740
MINING REACH SUBTOTAL	$6,918	$31,225	$60,630	$46,010	$55,490	$138,200	$97,435	$85,380	$10,415	$9,625	$541,328
ANNUAL REPORT:	$8,415	$9,927	$14,003	$11,336	$6,784	$16,798	$12,934	$8,930	$1,856	$963	$91,943
ANNUAL BUDGET TOTAL	$92,565	$109,192	$154,028	$124,696	$74,619	$184,773	$142,269	$98,230	$20,416	$10,588	$1,011,373
GRAND TOTAL:	$1,011,373										
YEARLY AVERAGE:	$101,137										

Table 1. Monitoring schedule based on a sequence of hypothesized peak flows, to illustrate the proposed monitoring scheme.

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Hypothetical annual peak discharge		*Q=3850cfs*	*Q=7280cfs*	*Q=2980cfs*	*Q=1200cfs*	*Q=10400cfs*	*Q=8010cfs*	*Q=6870cfs*		
CONSTRUCTION										
SRP 9 and 10										
GRAVEL MINING REACH		*PHASE II*			*PHASE IV*					
MONITORING										
SRP 9										
GEOMORPHOLOGY	pb	ab,rx		rx, n, xs, thal		rx*, xs, thal	xs	xs, thal		
FISHERIES	ef, sv, map	ef, sv, map, sss	ef, sv, sss	ef, sv, sss	sss	sss	sss	sss#		
RIPARIAN		ab, pp, $	$	pp		pp		pp		
SRP 10										
GEOMORPHOLOGY		pb			ab, rx, xs, thal	rx*, xs, thal	xs	xs, thal		
FISHERIES	ef, sv, map	ef, sv	ef, sv, sss	ef, sv, map, sss	sss	sss	sss	sss#		
RIPARIAN				ab, pp, $	$	pp		pp		pp
GRAVEL MINING REACH PHASE I										
GEOMORPHOLOGY	pb	ab,rx		n, rx, xs, thal		rx*, xs, thal	xs, thal	xs, thal		
FISHERIES	map	map, sss	sss	sss	sss	sss	sss	sss#		
RIPARIAN		ab, pp, $	bio, $	*pp*	*pp*	bio		pp, bio		
GRAVEL MINING REACH PHASE II										
GEOMORPHOLOGY		pb		ab, n, rx, thal		rx*, xs, thal	xs, thal	xs, thal		
FISHERIES		*map*	map, sss	sss	sss	sss	sss	sss#		
RIPARIAN			ab, pp, bio, $	$	pp	pp, bio	bio		pp, bio	
GRAVEL MINING REACH PHASE III										
GEOMORPHOLOGY	*pb*				ab, rx, thal	rx*, n, xs, thal	xs, thal	xs, thal		
FISHERIES			map	map, sss	sss	sss	sss	sss#		
RIPARIAN				ab, pp, $	$	pp, bio	pp, bio	bio		pp
GRAVEL MINING REACH PHASE IV										
GEOMORPHOLOGY			pb		ab, rx	rx*, xs, thal	n, xs, thal	xs, thal		
FISHERIES				map	map, sss	sss	sss	sss#		
RIPARIAN					ab, pp, $	$	pp	pp		pp
ANNUAL BUDGET:	$92,565	$109,192	$154,028	$124,898	$74,619	$184,773	$142,269	$98,230	$20,416	$10,588

Geomorphology symbols: pb=pre-built channel topography; ab=as-built channel topography; n=manning's "n"hydraulic calculation; rx= bed mobility with tracer rocks; thal= channel vertical adjustment w
xs= channel planform adjustment with cross-section profiles; *=bed mobility observed;

Fisheries symbols: ef=bass abundance by electrofishing, sv=smolt survival estimate; map=habitat mapping; sss=annual spawning and seining surveys; # denotes that spawning surveys will occur annu

Riparian symbols: pb=pre-built vegetation; ab=as-built vegetation; pp=project performance plots; bio=bioengineered bank protection; $=last year of irrigation

0 7 0 9 0 0 — I

I-009070

2.0 SRP 9 AND SRP 10

Aggregate mining at the SRP 9 and 10 sites has left in-channel pits disproportionately larger than the natural channel scale, eliminated a functional floodplain, and created preferred habitat for non-native predatory fish (largemouth and smallmouth bass). The SRP 9 site is 400 feet wide and up to 19 feet deep, and SRP 10 is up to 36 feet deep. The combined length of these reaches is less than one mile, but because of the severity of the channel and floodplain alterations and their strategic location below the primary chinook salmon spawning grounds, the SRP 9 and 10 sites severely impair channel geomorphic and riparian processes and limit chinook salmonid production by increasing smolt mortality (EA 1992). The goal of restoring this reach is to create a functionally scaled channel morphology in (or near) equilibrium with the contemporary hydrologic and geomorphic processes, which will improve chinook salmon survival by reducing predator habitat, abundance and predation rate. Specifically, the SRP 9 and 10 project objectives are to:

- Reduce non-native predator species abundance and habitat.
- Restore and increase salmonid habitat.
- Rebuild a natural channel geometry scaled to current channel forming flows and sediment supply.
- Restore and increase native riparian plant communities, establishing each species within the predicted hydrological niche of the contemporary hydrologic regime.

Because of the distinct biological objectives of the SRP projects, project monitoring prioritizes quantifying biological responses to hypothesized limiting factors. Thus geomorphic and riparian monitoring are less intensive in the SRP sites than in the Gravel Mining Reach.

2.1 FLUVIAL GEOMORPHIC PROCESSES

Restoring the SRP 9 and 10 sites will require large volumes of fill to meet specific project objectives of creating a functionally scaled channel geometry. Design and construction phases of the project must meet as-built performance criteria. Following final construction evaluation, the Monitoring Plan assumes responsibility for fluvial geomorphic monitoring of two objectives:

- document hydraulic design performance (project performance)
- document channel adjustment after construction

The monitoring timeline is built upon threshold flow events triggering specific monitoring actions. Channel morphology will be monitored prior to construction and then again immediately after construction to document as-built conditions. Subsequent monitoring will occur after each of three threshold high flow events. Three target discharge ranges are proposed: 4,000 to 7,000 cfs, 7,000 to 10,000 cfs, and 10,000 to 15,000 cfs; geomorphic monitoring will attempt to evaluate a flow event in each of these classes, for a maximum of three monitoring sequences. Flows exceeding 9,000 cfs are contingent upon Army Corp of Engineers issuing a variance in discharge limits, currently set at 9,000 cfs at Ninth Street, Modesto. More detailed descriptions of the proposed monitoring schedule are provided in the following sections.

2.1.1 Project Performance Topography

In the project design phase, a topographic map (digital terrain model) of the restoration site will be surveyed prior to construction. Cross section endpoints will be installed at fixed locations for future channel morphology monitoring. A digital terrain model depicting the design channel will then be used to develop construction specifications and to construct the project. Immediately after construction, a digital terrain topographic map will be re-surveyed to evaluate project compliance (compares as-built topography to design topography for contractual sign-off). The "as-built" topographic model will then help compare future channel adjustments revealed by monitoring cross sections (see Section 2.1.2). Bed surface particle size distribution will be documented at 1 or 2 selected reconstructed riffles immediately after construction as a baseline for comparing particle size adjustment from future high flow events.

Schedule: Topographic maps will be surveyed immediately after construction (tentatively winter 1998-2000 for SRP 9 and winter 2001-02 for SRP 10).

Hydraulics

Computations of floodway conveyance and geomorphic surface design (floodplains and terraces) depend on hydraulic roughness values. Manning's n is typically the roughness variable of choice, and is a function of particle size, bedforms (bars), sinuosity, vegetation, and other channel obstructions. When channel restoration and mitigation projects are constructed, the initial Manning's n is smaller (0.025 to 0.030) than it is after vegetation matures (0.035 and higher). These roughness values are typically estimated by back-calculation from other sites or from professional experience. By monitoring water surface elevations during discreet high flow events immediately after construction, roughness values can be back-calculated using HEC-RAS to compare observed versus design values, which can then be used to improve future designs. Additionally, floodplain and terrace inundation during discreet high flow events can be evaluated to determine if floodplains were inundated by discharges exceeding the design bankfull discharge. This monitoring will occur on SRP 9 only, and information will be used in the final design phase of SRP 10. Because the period in which riparian vegetation will begin to significantly increase Manning's n will exceed five years, the change in roughness as vegetation matures will not be included in this Monitoring Plan.

Schedule: Water surface elevations will be monitored during the first high flow after SRP 9 construction that equals or exceeds the design bankfull discharge. One flow event monitored.

Bed Mobility at Design Bankfull Discharge

A fundamental characteristic of properly functioning alluvial rivers is the initiation of bed surface mobility and bedload transport of the larger particle clasts at streamflows approaching bankfull discharge. Based on the anticipated future high flow regime, one objective of the project is to mobilize the bed surface particles by flows approaching and exceeding the design bankfull discharge. Evaluation of this objective will be monitored by placing painted tracer rocks on two riffle cross sections in the restored SRP 9 reach, or immediately downstream. Bed mobility in the SRP 10 reach will be inferred from SRP 9 monitoring results. The tracer rocks representing the D84 and D50 particle sizes will be placed on cross sections and monitored until a discharge large enough to initiate movement is observed. This discharge will then be compared to the design bankfull discharge to evaluate whether the design bankfull discharge would achieve the objective of mobilizing the bed surface. Water surface elevation and slopes will be measured to estimate the hydraulic variables of the discharge that mobilizes the bed surface particles.

Schedule: Tracer rocks will be installed immediately after SRP 9 construction is complete, and monitored after each high flow event until mobilization is observed. Some periodic maintenance will be required (i.e., repainting tracer rocks that fade, periodically checking for movement) if the mobilization flow does not occur in a reasonable time. One flow event monitored.

2.1.2 Channel Adjustment

Channel Migration/Planform Adjustment

Small-scale planform adjustments such as lateral movement will be documented by surveying cross sections at locations susceptible to lateral movement (apex of meanders). Large-scale planform adjustments will be documented by a combination of cross section evaluations and low-altitude aerial photographs (1"=500' or better contact print). Cross sections established during the pre-and post-construction topographic surveys will be relocated and surveyed with engineers levels and tapes to document channel adjustment. This objective will be monitored in both SRP 9 and SRP 10 restored reaches.

Schedule: Cross sections will be surveyed immediately after each of three high flow events that exceeds a threshold that causes channel adjustment (initially assumed at 5,000 cfs). Low-altitude aerial photos will be obtained once after a flow exceeding 10,000 cfs (and assumes flight costs are covered by other programs). Monitoring channel migration after each threshold high flow event is needed to evaluate any potential threat to human structures that requires maintenance. The magnitude of the threshold event will be estimated during the design phase. Up to two flow events monitored.

Channel Degradation/Aggradation

Vertical adjustment of the channel bed (bed aggradation/degradation) and floodplain (fine sediment deposition) will be documented at specific locations by surveying cross sections on bend of apex (pools) and at meander crossovers (riffles). A thalweg profile surveyed with an engineers level or total station will document changing bed elevation and pool/riffle sequencing (e.g., determine if pools are filling or readjusting longitudinally).

Schedule: Cross sections will be surveyed immediately after each of two high flow events that exceeds a threshold that causes channel adjustment (initially assumed at 5,000 cfs). Up to two flow events monitored.

2.2 Fisheries Resources

The SRP 9 and 10 sites currently provide habitat to predatory fish species, including non-native largemouth and smallmouth bass, striped bass, and the native Sacramento squawfish. A pilot predation study in the lower Tuolumne River (EA 1992, Appendix 22) identified twelve potential chinook salmon predator species, and subsequent studies at other SRPs estimated largemouth bass abundance in SRPs ranged from 133 to 181 fish per site (and projected to more than 10,000 largemouth bass river-wide) and predation rates as high as 3.6 to 5.3 salmon per predator per day for smallmouth bass during pulse flows. In sum, conditions are potentially unfavorable to emigrating juvenile chinook salmon. In addition, salmonid spawning and rearing habitat is lacking. The SRP restoration and mitigation projects are predicated in part on the hypothesis that these large pits contribute to an increase in juvenile salmon mortality and a consequent reduction in total salmon production. The principal biological objectives of the SRP 9 and 10 projects are to reduce salmon mortality by reducing predator habitat and abundance, and provide improved salmonid spawning and rearing habitat conditions.

Recommended biological monitoring protocols for the SRP sites include:

- field experiments comparing survival of juvenile chinook salmon passing through the project reaches before and after restoration.
- evaluation of bass species abundance before and after restoration, by electrofishing techniques and standardized statistical methods.

comparison of habitat availability by habitat mapping before and after restoration. for various life history stages of predator species and chinook salmon.

An initial investigation of each monitoring approach is recommended during the first year to determine the relative utility of each monitoring effort and its ability to detect hypothesized responses. Findings from this initial effort can then focus resource expenditure in the following years (adaptive management approach).

2.2.1 Juvenile Salmonid Survival Estimates

Non-native bass species prey on emigrating chinook juveniles and smolts. A direct measure (assuming everything is equal) of project efficacy would be to quantify smolt survival through the project reaches before and after project implementation. Our study plan emphasizes replicated field tests of marked-recapture survival estimates. based on releases of test groups of natural chinook smolts above the restoration site. and recapture below the test site using rotary screw traps (RST), possibly in conjunction with fyke nets, to generate an index of smolt survival. The survival index is based on the proportion of released fish recaptured. adjusted by the estimated trap efficiency. This recommendation follows an evaluation of various sampling methods and gear types, and recognition that these efforts can be partially incorporated into other monitoring programs currently employed on the Tuolumne River.

Test fish will be collected at an upstream site currently used in river-wide monitoring programs. and marked using PanJet dye inoculation. fin clips or other methods. The marking systems will be coordinated with other Tuolumne River monitoring programs. The number of distinct experiments will depend on the availability of test fish and personnel for marking fish. but may include 2 to 3 test runs each season. The availability of fish may limit this work. but there are opportunities to incorporate use of hatchery produced smolts for studies as well. The number of fish per test may need to be modified (increased or decreased) in subsequent years depending on results of the first year's results. Tests should target peak periods of smolt movement. and use only migrating fish captured in upstream screw traps or fyke nets. since these fish show a propensity to move downstream. Tests should also target pulse flows and non-pulse flow periods to test hypotheses about the utility of pulse flows. Small numbers of hatchery (Merced) smolts may periodically be required to ensure adequate test values.

Smolt survival studies (and similar production estimates) using CWT marked recapture methodologies and rotary screw trapping have been implemented annually on the Tuolumne by CDFG. and contain considerable uncertainty in their estimates of survival and river-wide production. In addition. they often depend on hatchery-produced juvenile chinook for release groups large enough to satisfy statistical requirements. Other problems such as differences in diel movement of smolts. trap avoidance, and comparisons of behavioral differences between hatchery and naturally produced smolts have not been resolved. Pending the outcome of the initial year of reach specific survival studies, we may recommend other methods to obtain survival estimates.

Schedule: Survival estimates will be conducted for four years, beginning in 1998 before SRP 9 construction. and continuing for two years after completion of SRP 10 (through 2003).

2.2.2 Bass Abundance

Bass population densities are expected to decline as a result of project implementation. and changes in fish abundance can potentially be detected using a variety of monitoring methods . The Monitoring Plan includes a statistical comparison of predator abundance before and after project implementation. estimated by electrofishing, to document changes that result from restoration. Predator populations will be sampled in the SRP 9 and 10 treatment sites. in an undisturbed control site at SRP 7 or SRP 8. and in one or two sites similar to post-restoration conditions. Reference sites will be useful to isolate specific project-related responses from annual local variability in population abundance, and may also help determine if population responses in treatment reaches are redirected to other sites (e.g., increased abundance in other SRP's as a result of project-site displacement). The SRP treatment and reference sites will be electrofished at night to estimate abundance of adult largemouth, smallmouth and striped basses, and Sacramento squawfish. Field methods will employ gillnets and blocking nets when needed, and use multiple-pass depletion removal or marked-recapture methods for estimating fish abundance. The electrofishing equipment best suited to sampling in the large SRP units is a boat shocker (e.g., Smith-Root). Snorkeling may also be used as an additional method for comparative purposes, or to sample habitats not easily sampled by other techniques.

The initial approach to surveying predator abundance will be to conduct a multiple marked-recapture experiment over a several week period (at fewer sites) and then, if feasible, conduct a multiple pass depletion removal test on the last marked-recapture run to obtain two separate abundance estimates. This pilot study approach would help determine which method has the most merit for reliable estimates of predator density or abundance and would allow a determination of subsequent effort required to accurately estimate abundance. Fish species and counts other than those specified above will be recorded for presence or absence, but abundance estimates will not be attempted for those species. Also, lavage techniques will be used for concurrent cursory level evaluation of the diet habits of the main predatory species.

Reference sites selected that resemble anticipated post-project conditions will be monitored by electrofishing and/or snorkeling according to the above schedule. As there are no riffles in the vicinity upstream of the project site, these references sites will be located below SRP 10 in the vicinity of riffle 73A, 73B or 74 (RM 25.0). Some modifications to field techniques may be required at these reference sites and in post-construction SRP 9 and 10 reaches, dictated primarily by water depths and velocities.

Schedule: Electrofishing will take place during spring/summer 1998 to establish pre-project abundance and suitable techniques, and then again in May/June spring/summer of the following 3 years (1999, 2000, and 2001) to evaluate post-restoration conditions and to track short-term trends in bass abundance. Pre- and post-restoration sampling in SRP 10 will perform the dual function of providing two years of reference conditions for comparison to SRP 9 and also to establish baseline conditions for SRP 10, scheduled for restoration in 2000. SRP 10 and accompanying reference sites will be monitored through 2002. At least one year of monitoring should accompany a high-flow event to provide insight into predator persistence in relation to high flows in reconstructed habitat. We also recommend continued sampling of SRP 7 or 8 reference site and SRP 9 and SRP 10 project site to track long-term trends in abundance, particularly if other channel reconstruction projects are anticipated (e.g., SRP 5 and SRP 6), but recognize that funding is not presently allocated for this monitoring.

2.2.3 Bass and Salmonid Habitat Availability

Methods to quantify habitat availability generally rely on data collected from cross-section transects and IFIM models, which can be labor intensive and provide data of limited use. Our study plan will quantify habitat availability and changes in pre-and post-restoration conditions by field mapping habitat area onto aerial photographs. Maps showing physical habitat boundaries of greater resolution for fish species such as pools, riffles, runs, SRPs and backwater areas will be produced from aerial photos, and will provide the physical backdrop for delineating habitat boundaries for impacted fish species such as chinook salmon and bass. Identifying habitat boundaries will be based on specified criteria for species habitat preferences, and will focus on predator species spawning and rearing habitat in addition to salmonid habitat preferences. These criteria will include variables such as depth and velocity preferences for each species, determined according to site-specific information when available, or otherwise will refer to published literature values of habitat preferences. A full set of criteria will be defined for each species of interest prior to field

Mapping. High resolution aerial photographs available from project construction (1"=2,000 ft or better) will provide field templates for mapping habitat boundaries. These maps offer the flexibility of later incorporating habitat boundaries for other fish species, amphibians, migratory birds, etc. Data will be digitized for comparing habitat areas before and after construction, and presented in planform color format. Where possible, we recommend quantifying habitat boundaries in reference to a common denominator such as alternate bar sequences, which are repeatable geomorphic features that can be treated statistically and compared to other river reaches.

Verification of habitat use by various life stages of fish species will provide important information for evaluating the success of project objectives. We will employ direct observation or seining during field mapping to establish the presence of juvenile salmonids and bass. These activities will be done using a systematic sampling design to test hypotheses about habitat preferences. Additionally, seining efforts similar to those conducted by the Districts will be used in the SRP 9 and 10 reaches to assess habitat use by rearing salmonids during subsequent seasons. CDFG seasonal spawning surveys will also incorporate newly created spawning habitat within the project boundaries. Two field days will be provided for CDFG personnel for field calibration of redd counts to spawner surveys.

Schedule: Pre-construction habitat maps will be prepared in summer 1998 for SRP 9 and summer 1999 for SRP 10, and post construction maps will be prepared in 2000 for SRP 9 and in 2002 for SRP 10. Spawning and seining surveys will begin during the appropriate season following construction, and continue indefinitely for spawning surveys, and for four years post-construction for seining.

2.3 Riparian Resources

A major component of the SRP 9 and SRP 10 project is riparian revegetation. Native riparian vegetation consists of different plant assemblages called plant series (Sawyer 1995). Currently these sites have fragmented native vegetation and many exotic plant species created by a legacy of land alteration. Project construction will disturb some riparian vegetation and will be mitigated through extensive revegetation. The revegetation objective is to establish different plant series on reconstructed surfaces with inundation patterns characteristic of that plant series, provide continuity between remnant riparian stands, and increase natural regeneration.

2.3.1 Project Performance

Riparian monitoring will evaluate project performance using plot-based descriptions of species composition, survival, and cover to evaluate recruitment, survival and growth. Potential performance standards for plantings are: 90 % plant survival in year 0, 70% plant survival to year 2, and 60% survival to year 3, a 10% increase in cover and growth annually for surviving plants, and no more than ten planted hardwoods dead in a 3 meter radius. Plantings will be irrigated in the first and second growing season after revegetation. Trends in survival will be documented and used to evaluate project success in establishing self sustaining vegetation series. Quantitative performance standards will be correlated to revegetation techniques such as design, planting, and irrigation methods, fertilizer, root stock quality, and environmental causes. Oaks should be propagated from local acorns found near the project area.

Plot descriptions will sample plant series on each restored geomorphic surface, including the active channel, floodplain and terrace. Three permanent plots will be established within each restored series type, with each plot located along cross sections established for geomorphic monitoring. Data collected within plots will include dominant species, plant vigor, and plant size in the tree, shrub, and herb strata. Plant vigor will be assessed using visual decline indicators (for example, yellowing or burnt leaves, leaf abscission, stunted growth, irregular plant morphology, or stem death). Plant size assessment will be based on root collar or breast height diameter and height. Plant density, and survivorship will also be calculated.

Changes in plant size, vigor or species composition will be used to evaluate revegetation success. It will be necessary to protect trees from beavers and this may include temporary depredation permits from CDFG.

Schedule: Monitoring will begin immediately after construction (year-0) to evaluate planting success and document as-built conditions, and again at year-2 at the end of irrigation (contractual signed off pending results). Additional monitoring will occur in years 3 and 5, or potentially after a high flow event that exceeds the channel geomorphic design flow (assumed to be 5,000 cfs) and inundates reconstructed floodplains, for a maximum 4 monitoring seasons for the first 5 years after construction. The final riparian vegetation monitoring will occur in 2004 for SRP 9 and 2006 for SRP 10.

2.4 Wetlands

2.4.1 Jurisdictional Wetlands

Wetland area was assessed using National Wetlands Inventory maps. These maps revealed no wetlands in addition to those mapped as channel, mining pits, or riparian vegetation by the riparian inventory. However, these maps are very general in nature and cannot provide information sufficient to identify wetlands subject to the jurisdiction of the Corps of Engineers under Section 404 of the Clean Water Act. Field surveys are recommended to identify such jurisdictional wetlands. If jurisdictional wetlands are identified in the work or access route area, the wetlands should be avoided to the extent practicable. Any work in jurisdictional wetlands would require coordination with the Corps of Engineers.

Schedule: Prior to submittal of the Section 404 permit under the Clean Water Act.

2.5 Threatened And Endangered Species

2.5.1 Plants

Surveys are recommended for all plant species that are considered to possibly or likely occur or have been documented as present at the site. Surveys are not recommended for species considered unlikely to occur. Threatened, endangered, or special status plant species potentially present at the SRP 9 and SRP 10 include: delta button-celery, California hibiscus, red-flowered lotus, Merced monardella, Hartweg's golden sunburst, and Sanford's arrowhead. This list may be reduced pending additional review by and coordination with the U.S. Fish and Wildlife Service Endangered Species Office and the California Department of Fish and Game. To the extent possible, surveys will take a two-phased approach. For species for which it is unclear whether habitat occurs on-site, the first phase will document habitat occurrence or absence. The second (more intensive) phase will document species occurrence or absence.

Schedule: Surveys will be based on predicted flowering periods. However, flowering can vary slightly depending on climatic conditions and elevation. Additionally, some of the species may be identifiable during other seasons by foliage or fruit. At least one spring and one summer survey would likely be necessary to determine presence or absence of all anticipated plant species.

2.5.2 Animals

To confirm the presence or absence of threatened, endangered, or special status animal species and avoid potential impacts to them, surveys are recommended. Surveys are recommended for all animal species that are considered possibly or likely to occur or have been documented as present at the site. No surveys are recommended for animal species unlikely to occur. Surveys are recommended for the valley elderberry longhorn beetle, California red-legged frog, foothill yellow-legged frog, western pond turtle, Clark's/western grebe, double-crested cormorant, great blue heron, great egret, snowy egret, osprey, white-